TECHNICAL DATA 0
DIAGNOSTICS 1
CE ENGINE FUEL SYSTEM 2
CE ENGINE INLET/EXHAUST SYSTEM 3
CE ENGINE, ENGINE BRAKE 4
PE ENGINE FUEL SYSTEM 5
PE ENGINE INLET/EXHAUST SYSTEM 6
ENGINE BRAKE, PE ENGINE 7
XE ENGINE FUEL SYSTEM 8
XE ENGINE INLET/EXHAUST SYSTEM 9
ENGINE BRAKE, XE ENGINE 10

0

CONTENTS

		Page	Date
1.	**ENGINE, GENERAL**	1-1	200416
1.1	General	1-1	200416
1.2	CE engine, general	1-3	200416
1.3	PE engine, general	1-4	200416
1.4	XE engine, general	1-5	200416
2.	**CE ENGINE FUEL SYSTEM**	2-1	200416
2.1	General	2-1	200416
2.2	Tightening torques	2-3	200416
3.	**CE ENGINE INLET/EXHAUST SYSTEM**	3-1	200416
3.1	General	3-1	200416
3.2	Tightening torques	3-2	200416
4.	**PE ENGINE FUEL SYSTEM**	4-1	200416
4.1	General	4-1	200416
4.2	Tightening torques	4-2	200416
5.	**PE ENGINE INLET/EXHAUST SYSTEM**	5-1	200416
5.1	General	5-1	200416
5.2	Tightening torques	5-2	200416
6.	**XE ENGINE FUEL SYSTEM**	6-1	200416
6.1	General	6-1	200416
6.2	Tightening torques	6-2	200416
7.	**XE ENGINE INLET/EXHAUST SYSTEM**	7-1	200416
7.1	General	7-1	200416
7.2	Tightening torques	7-3	200416
8.	**ENGINE BRAKE, XE ENGINE**	8-1	200416
8.1	General	8-1	200416
8.2	Tightening torques	8-2	200416

0

© 200416

0

1. ENGINE, GENERAL

1.1 GENERAL

CE engine

Cold engine	A cold engine is an engine which, having reached operating temperature, has been allowed to cool down for at least **six hours**.
Warm engine	A warm engine is an engine which, having reached operating temperature, has not been at a standstill for more than **thirty minutes**.
Direction of rotation of the engine	The direction of rotation of the engine is clockwise, as seen from the vibration damper end.
First cylinder of the engine	The first cylinder of the engine is the cylinder at the vibration damper end of the engine.
Left-hand and right-hand side of the engine	The left-hand side of the engine is the side where the air compressor and electronic unit are mounted. The right-hand side of the engine is the side where the turbocharger and oil filter are mounted.

PE/XE engine

Cold engine	A cold engine is an engine which, having reached operating temperature, has been allowed to cool down for at least **six hours**.
Warm engine	A warm engine is an engine which, having reached operating temperature, has not been at a standstill for more than **thirty minutes**.
Direction of rotation of the engine	The direction of rotation of the engine is clockwise, as seen from the timing gear end.
First cylinder of the engine	The first cylinder of the engine is the cylinder at the timing gear end.
Left-hand and right-hand side of the engine	The left-hand side of the engine is the side where the fuel pump is mounted. The right-hand side of the engine is the side where the air compressor is mounted.

0

Engine identification
Engine number
The engine number is located in two places on the engine:

stamped into the engine block
- CE: top of the oil cooler
- PE: above the compressor
- XE: above the UPEC unit

on the type plate
- CE: on the timing gear case or the flywheel housing (depending on the production date)
- PE: on the inlet manifold
- XE: on the inlet manifold

Engine type
The type number XE315C1 indicates:

X engine family	X =	12.6 ltr.
	P =	9.2 ltr.
	C =	5.88 ltr.
E engine version	E =	electronic timing
	S =	turbocharger intercooler
315 engine output in kilowatt (kW)		
C Euro emissions	C =	Euro 3
	M =	Euro 2
	L =	Euro 1
1 Engine version number	1 =	first update

0

1.2 CE ENGINE, GENERAL

Engine types

Coding	CE 136 C CE 162 C CE 184 C

General specifications

Environmental standard	Euro 3 (C)
Number of cylinders	6 cylinders in line
Valves	4 valves per cylinder
Bore x stroke	102 x 120 mm
Cubic capacity	5.9 litres
Compression ratio	17,3 : 1
Fuel injection	direct injection
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Engine management system	ECS-DC3
Cooling	fluid
Weight	approx. 500 kg

Engine speeds, CE engine

Engine type	Idling rpm	Maximum no-load rpm
CE 136 C	600 - 800	approx. 2500
CE 162 C	600 - 800	approx. 2500
CE 184 C	600 - 800	approx. 2500

0

1.3 PE ENGINE, GENERAL

Engine types

Coding	PE 183 C 1 PE 228 C PE 265 C

General specifications

Environmental standard	Euro 3 (C)
Number of cylinders	6 cylinders in line
Valves	4 valves per cylinder
Bore x stroke	118 x 140 mm
Cubic capacity	9.2 litres
Compression ratio	17,5 : 1
Fuel injection	direct injection
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Engine management system	UPEC
Cooling	fluid
Weight	approx. 860 kg

Engine speeds, PE engine

Engine type	Idling rpm	Maximum free-running rpm
PE 183 C1	575 - 625	Approx. 2580
PE 228 C	575 - 625	Approx. 2580
PE 265 C	575 - 625	Approx. 2580

0

1.4 XE ENGINE, GENERAL

Engine types

Coding	XE 250 C 1 XE 280 C 1 XE 280 C 3 (4 öko) XE 315 C 1 XE 315 C 3 (4 öko) XE 355 C 1

General specifications

Environmental standard	Euro 3 (C)
Number of cylinders	6 cylinders in line
Valves	4 valves per cylinder
Bore x stroke	130 x 158 mm
Cubic capacity	12.6 litres
Compression ratio	17,4 : 1
Fuel injection	direct injection
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Engine management system	UPEC
Cooling	fluid
Weight	approx. 1,080 kg

Engine speeds, XE engine

Engine type	Idling rpm	Maximum free-running rpm
XE 250 C1	525 - 575	approx. 2200
XE 280 C1/C3	525 - 575	approx. 2200
XE 315 C1/C3	525 - 575	approx. 2200
XE 355 C1	525 - 575	approx. 2260

0

© 200416

0

2. CE ENGINE FUEL SYSTEM

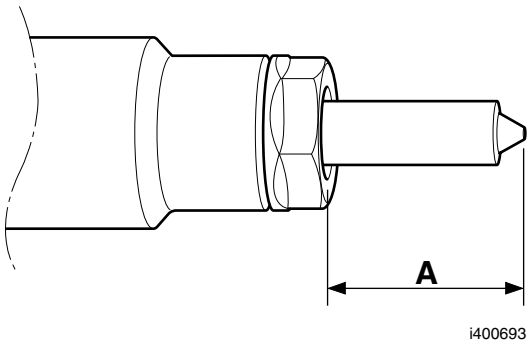
2.1 GENERAL

Fuel level element	
Angular displacement	86°
Resistance value	
- Full	approx. 500 Ω
- ¾	approx. 355 Ω
- ½	approx. 234 Ω
- ¼	approx. 137 Ω
- Not used	approx. 33 Ω
Vacuum relief valve opening pressure	10 - 20 mbar
Pressure relief valve opening pressure	200 - 300 mbar
Fuel fine filter	
Maximum pressure drop across fuel fine filter	2.0 bar
Fuel lift pump	
Fuel lift pump pressure in front of fine filter (with engine at idling speed)	5 - 13 bar
Fuel lift pump pressure behind fine filter (with engine at idling speed)	3 - 11 bar
Pressure relief valve opening pressure	11 bar
Maximum underpressure on suction side of fuel lift pump	0.5 bar
High-pressure pump	
Pump pressure (dependent on the operating mode of the engine and the electronic calibration)	300 - 1400 bar
Fuel rail	
Fuel rail pressure (dependent on the operating mode of the engine and the electronic calibration)	300 - 1400 bar
Fuel rail pressure-limiting valve	
Opening pressure	1650 bar
Injector	
Number of holes in injector	8
Resistance of magnet coil	0.15 - 0.5 Ω

0

Injector washer

Nozzle length (distance A)	Washer thickness
21.5 ± 0.2 mm	1.5 mm
23.0 ± 0.2 mm	3.0 mm



i400693

Fuel return overflow valve

Fuel return overflow valve opening pressure	1.2 - 2.0 bar

Fuel return pipe

Maximum return pipe pressure build-up	0.2 bar

Return fuel measurement

Maximum quantity of return fuel at idling speed	180 ml/min.
Permitted minimum time for filling a measuring beaker to a volume of 360 ml	2 min.

2.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Electronic unit cooling plate	
Attachment bolts holding the electronic unit to the cooling plate	10 Nm
Attachment bolts holding the cooling plate to the engine block	24 Nm
VOSS quick-release coupling fittings	18 Nm
Low-pressure fuel pipes	
Banjo bolts	24 Nm
VOSS quick-release coupling fittings	24 Nm
Fuel return overflow valve in cylinder head	24 Nm
High-pressure pump	
Attachment nuts holding the high-pressure pump to the timing gear case	25 Nm
High-pressure fuel pipe	
High-pressure pipe union nut	22 Nm
Fuel rail	
Attachment bolts	24 Nm
Pressure-limiting valve	100 Nm
Injector pipes	
Injector pipe union nuts	22 Nm
Fuel supply pipe	
Fuel supply pipe nut	50 Nm
Injectors	
Injector clamping bracket attachment bolts	10 Nm
Injector electrical connection	1.5 Nm

0

© 200416

0

3. CE ENGINE INLET/EXHAUST SYSTEM

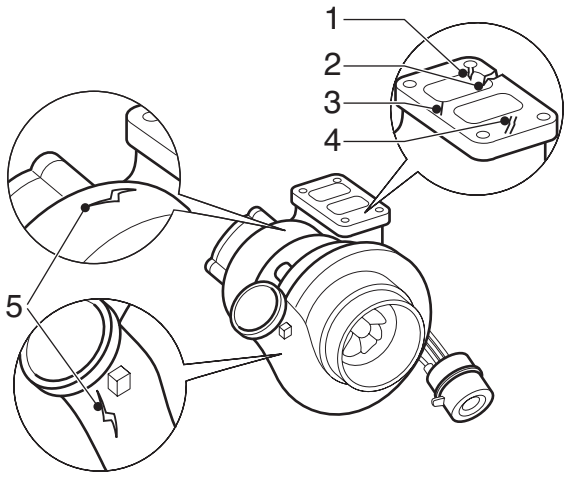
3.1 GENERAL

Turbocharger

CE 136 C	Holset HY 35 W
CE 162 C	Holset HY 35 W
CE 184 C	Holset HX 35 W

Minimum actuating pressure of wastegate capsule under which the control rod will move	2.0 bar
Axial bearing play of compressor shaft	0.038 - 0.093 mm
Radial bearing play of compressor shaft	0.329 - 0.501 mm

Rejection standards for cracking
1. Cracks in the connector flange must not reach as far as the attachment holes.
2. Cracks in the connector flange must not reach from the channels as far as the exterior.
3. Cracks in the connector flange may not be longer than 15 mm.
4. Cracks in the connector flange must not be less than 6 mm apart.
5. There must be no cracks in the housing.



i400784

Exhaust gas back pressure

At full-load engine speed	100 mbar
Maximum back pressure during engine brake application	4.3 bar

Inlet underpressure

At full-load engine speed (clean air filter)	25 mbar
At full-load engine speed (clogged air filter)	62 mbar

Glow element

Resistance value	180 - 220 mΩ

0

3.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Turbocharger	
Attachment nuts, exhaust manifold flange/turbocharger	43 Nm (1)
Oil discharge pipe attachment bolts	23 Nm
Oil supply pipe union	28 Nm
Turbocharger V-clamp	10 Nm

(1) Fasten with Copaslip

Glow element	
Attachment bolts	14 Nm

Air cooler	
Hose clamps	7 Nm

4. PE ENGINE FUEL SYSTEM

4.1 GENERAL

Gallery pressure

At starting speed	approx. 0.5 - 1.0 bar
At idling speed	approx. 2.5 - 3.0 bar
At maximum no-load engine speed	approx. 6.5 - 7.0 bar

Fuel level element

Angular displacement	86°
Resistance rating	
- Full	approx. 500 Ω
- ¾	approx. 355 Ω
- ½	approx. 234 Ω
- ¼	approx. 137 Ω
- Not used	approx. 33 Ω
Underpressure valve opening pressure	10 - 20 mbar
Overpressure valve opening pressure	200 - 300 mbar

Overview of injectors

Engine type	Number of holes in injector	Nozzle no.	Hole diameter	Bar filter	Opening pressure
PE 183 C1	8	1080	0,175	Yes	300 + 10 bar
PE 228 C	8	1080	0,175	Yes	300 + 10 bar
PE 265 C	8	1080	0,175	Yes	300 + 10 bar

Fuel lift pump

Fuel lift pump pressure	7.0 - 8.0 bar
Pressure relief valve opening pressure	approx. 8.5 bar

Pump housing

Weight, including camshaft and pump units	approx. 70 kg
Pressure relief valve opening pressure	approx. 5.5 - 6 bar

0

4.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Injector pipes	
Injector pipe union nuts	30 Nm
Fuel filter housing	
Fuel leak-off pipe union	20 Nm
Fuel filter cap	25 Nm
Injectors	
Clamping piece attachment bolt	30 Nm + 60° angular displacement (1)
Leak-off pipe banjo bolt	20 Nm

(1) Use bolts once only.

Pump housing	
Pressure relief valve	20 Nm
Attachment bolts to connect pump housing to engine block	60 Nm
Pump housing rear cover attachment bolts	30 Nm
Attachment bolts for pump camshaft locking plate	30 Nm
Attachment bolts for pump housing sealing plates	30 Nm
Attachment bolts for pulse disk on camshaft	30 Nm (1)
Attachment bolt, camshaft sensor	8 Nm
Non-return valve	45 Nm
Fuel temperature sensor	20 Nm

(1) Use Loctite 243

Pump units	
Bolts for attaching pump units to pump housing	46 Nm
Pump unit electrical connection	1 Nm
Fuel lift pump	
Attachment bolts to connect fuel lift pump to pump housing	30 Nm (1)

(1) Use Loctite 243

5. PE ENGINE INLET/EXHAUST SYSTEM

5.1 GENERAL

Explanation of turbocharger type designation
Example of type designation:
GT40-88S/54NPS/0.95-84

GT40	Turbine type designation
88	Maximum compressor rotor diameter
S	Wastegate model
54	Compressor rotor trim
NPS	Version with intake side without compressor housing bypass
PS	Version with intake side with compressor housing bypass
0.95	Turbine housing size
84	Turbine rotor trim

Exhaust back pressure

At full-load engine speed	80 - 90 mbar

Inlet underpressure

At full-load engine speed (clean air filter)	25 - 35 mbar
At full-load engine speed (clogged air filter)	54 - 64 mbar

Turbocharger

Control rod movement of control bypass at 1.8 bar	1 mm
Stud bolts for fastening	Copaslip

0

5.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Turbocharger	
Heat shield attachment bolts	30 Nm (1)
Turbine housing clamp plate attachment nut	15 Nm
Exhaust manifold flange/turbocharger attachment nuts	60 Nm (2)
Elbow attachment with exhaust brake on turbocharger	40 Nm
Oil supply pipe banjo bolt	90 Nm

(1) Use Loctite 243 to secure
(2) Fasten with Copaslip

Glow element	
Attachment bolts	30 Nm

Air cooler	
Air cooler hose clamps	10 Nm

0

6. XE ENGINE FUEL SYSTEM

6.1 GENERAL

Gallery pressure

At starting speed	approx. 0.5 - 1.0 bar
At idling speed	approx. 2.5 - 3.0 bar
At maximum no-load engine speed	approx. 6.5 - 7.0 bar

Fuel level element

Angular displacement	86°
Resistance value	
- Full	approx. 500 Ω
- ¾	approx. 355 Ω
- ½	approx. 234 Ω
- ¼	approx. 137 Ω
- Not used	approx. 33 Ω
Vacuum relief valve opening pressure	10 - 20 mbar
Pressure relief valve opening pressure	200 - 300 mbar

Overview of injectors

Engine type	Number of holes in injector	Nozzle no.	Hole diameter	Bar filter	Opening pressure
XE 250 C1	8	1081	0.182	Yes	300 + 10 bar
XE 280 C1/C3	8	1081	0.182	Yes	300 + 10 bar
XE 315 C1/C3	8	1081	0.182	Yes	300 + 10 bar
XE 355 C1	8	1286	0.182	Yes	300 + 10 bar

Fuel lift pump

Fuel lift pump pressure	7.0 - 8.0 bar
Pressure relief valve opening pressure	approx. 8.5 bar

Pump housing

Weight, including camshaft and pump units	approx. 70 kg
Pressure relief valve opening pressure	circa 5.5 - 6 bar

0

6.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Injector pipes	
Injector pipe union nuts	30 Nm
Fuel filter housing	
Fuel leak-off pipe union	20 Nm
Fuel filter cap	25 Nm
Injectors	
Clamping piece attachment bolt	30 Nm + 60° angular displacement (1)
Leak-off pipe banjo bolt	20 Nm

(1) Use bolts once only.

Pump housing	
Pressure relief valve	20 Nm
Attachment bolts to connect pump housing to engine block	60 Nm
Pump housing rear cover attachment bolts	30 Nm
Attachment bolts for pump camshaft locking plate	30 Nm
Attachment bolts for pump housing sealing plates	30 Nm
Attachment bolts for pulse disk on camshaft	30 Nm (1)
Attachment bolt, camshaft sensor	8 Nm
Non-return valve	45 Nm
Fuel temperature sensor	20 Nm

(1) Use Loctite 243

Pump units	
Bolts for attaching pump units to pump housing	46 Nm
Pump unit electrical connection	1 Nm
Fuel lift pump	
Attachment bolts to connect fuel lift pump to pump housing	30 Nm (1)

(1) Use Loctite 243

0

7. XE ENGINE INLET/EXHAUST SYSTEM

7.1 GENERAL

Explanation of K.K.K. turbocharger type designation

Example of type designation: K31-39 71 Q Y B KB
22.9 1 D C A Y D

K31	Turbine build series
39	diameter of compressor rotor 3.9 inch
71	diameter ratio of compressor rotor d/d
Q	Compressor rotor development letter
Y	Compressor housing development letter
B	Compressor housing variant
K	k = compressor housing with recirculation (= ported shroud) a = compressor housing with no recirculation (= non-ported shroud)
b	b = recirculation variant a = no recirculation
22	surface of turbine housing throat (cm^2)
9	turbine housing version number 9 = with control bypass 2 = without control bypass
1	Turbine trim figure: = d/d = 89.5 (trim 80) = d/d = 87 (trim 76) = d/d = 84 (trim 70) = d/d = 79 (trim 62)
D	Turbine rotor development letter
C	Turbine housing development number
A	Turbine housing variant
Y	Turbine inlet flange size y = dimension for a 12.6 litre engine w = size for a 9.2 litre engine t = size for a 6.2 litre engine
D	Turbine housing material: b = GG 40 d = Simo f = Nirisist d2 h = Nirisist d3 k = Nirisist d5

0

Explanation of GARRETT turbocharger type designation

Example of type designation: GT40-88S/54NPS/ 0.95-84

GT40	Turbine type designation
88	Maximum compressor rotor diameter
S	Wastegate model
54	Compressor rotor trim
NPS	Version with intake side without compressor housing bypass
PS	Version with intake side with compressor housing bypass
0.95	Turbine housing size
84	Turbine rotor trim

Turbocharger

Stud bolts for fastening	Copaslip

GARRETT wastegate

Movement of control rod at 1.60 ± 0.05 bar	1.0 mm

K.K.K. wastegate

Movement of control rod at 1.95 ± 0.05 bar	3.5 ± 0.05 mm

Exhaust back pressure

At full-load engine speed	90 mbar

Inlet underpressure

At full-load engine speed (clean air filter)	50 mbar
At full-load engine speed (clogged air filter)	75 mbar

7.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Turbocharger	
Heat shield attachment bolts	30 Nm (1)
Turbine housing clamp plate attachment nut	15 Nm
Exhaust manifold flange/turbocharger attachment nuts	60 Nm (2)
Elbow attachment with exhaust brake on turbocharger	40 Nm
Oil supply pipe banjo bolt	90 Nm

(1) Use Loctite 243 to secure
(2) Fasten with Copaslip

Glow element	
Attachment bolts	30 Nm

Air cooler	
Air cooler hose clamps	10 Nm

0

© 200416

8. ENGINE BRAKE, XE ENGINE

8.1 GENERAL

DEB solenoid valve	
Resistance rating	
Cold (20°C)	32,6 - 36,8 Ω
Hot (80°C - 100°C)	41,8 - 46,1 Ω
DEB oil pressures	
Minimum cut-in pressure	1.5 bar
Maximum service pressure	4.5 bar
Maximum pressure of DEB control valve	8.0 bar
DEB settings	
DEB clearance	1.40 mm
Exhaust brake	
Calibration of butterfly valve opening:	
- with DEB	14 mm
- without DEB	10.5 mm

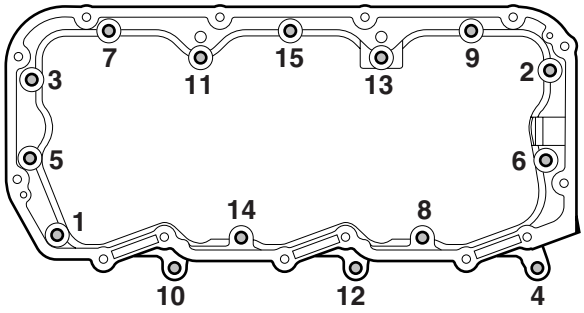
0

8.2 TIGHTENING TORQUES

The tightening torques specified in this paragraph are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.
When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

DEB

Valve cover attachment bolts	25 Nm
Rocker setting bolt lock nut	40 Nm
Bridge piece setting bolt lock nut	40 Nm
DEB attachment bolts	110 Nm
DEB set screw nut	25 Nm
Solenoid valve	20 Nm
Wiring harness attachment bolt	5 Nm
Spring plate attachment bolt	12.5 Nm
Valve sleeve attachment bolts	30 Nm (1)



M200942

(1) Tighten the attachment bolts in the order indicated

Exhaust brake

Exhaust brake elbow attachment nuts on turbo-charger	40 Nm (1)
Heat shield attachment bolts	30 Nm (2)

(1) Fasten with Copaslip
(2) Use Loctite 243 to secure

CONTENTS

		Page	Date
1.	**TRACTIVE PROBLEMS**	1-1	200416
1.1	Tractive problems	1-1	200416
2.	**CE ENGINE FUEL SYSTEM**	2-1	200416
2.1	Introduction	2-1	200416
2.2	Fault-finding table	2-2	200416
3.	**CE ENGINE INLET/EXHAUST SYSTEM**	3-1	200416
3.1	Introduction	3-1	200416
3.2	Fault-finding table	3-2	200416
4.	**ENGINE BRAKE, CE ENGINE**	4-1	200416
4.1	Introduction	4-1	200416
4.2	Fault-finding table	4-2	200416
5.	**FUEL SYSTEM, XE/PE ENGINE**	5-1	200416
5.1	Introduction	5-1	200416
5.2	Fault-finding table	5-2	200416
6.	**XE/PE ENGINE INLET/EXHAUST SYSTEM**	6-1	200416
6.1	Introduction	6-1	200416
6.2	Fault-finding table	6-2	200416
7.	**ENGINE BRAKE, XE/PE ENGINE**	7-1	200416
7.1	Introduction	7-1	200416
7.2	Fault-finding table	7-2	200416

© 200416

1

1. TRACTIVE PROBLEMS

1.1 TRACTIVE PROBLEMS

The first test that has to be carried out when investigating tractive problems is the acceleration test.

1

2. CE ENGINE FUEL SYSTEM

2.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

2.2 FAULT-FINDING TABLE

SYMPTOM: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
No fuel supply/high-pressure pump or fuel lift pump defective; no delivery	Check: - the fuel level - the rail pressure - the pipes for blockage and leaks - the fuel lift pump - the high-pressure pump

SYMPTOM: ENGINE STALLS AND RUNS AGAIN AFTER RE-STARTING	
Possible cause	**Remedy**
Air in fuel system	Check for drawing in of air: - via the suction pipe

SYMPTOM: ENGINE STARTS POORLY	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump
Internal fuel leak between fuel supply pipe(s) and injector(s)	Check the quantity of return fuel

SYMPTOM: ENGINE RUNS AT (INCREASED) IDLING SPEED AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	**Remedy**
Mechanical defect of accelerator pedal sensor	Check: - mechanical connection of sensor/accelerator pedal - accelerator pedal sensor

SYMPTOM: DIESEL KNOCK DURING ACCELERATION	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe
Injector defective	Check the injectors

SYMPTOM: IRREGULAR RUNNING OF ENGINE	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
Injector defective	Check the injectors
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
Mechanical defect of accelerator pedal sensor	Check: - mechanical connection of sensor/accelerator pedal - accelerator pedal sensor
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	**Remedy**
Fuel fine filter/coarse filter partially clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
Air leak in inlet system	Pressure-test the inlet system

1

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	**Remedy**
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump
Fault in electrical components/wiring of: - connectors	Check the electrical system

SYMPTOM: ENGINE SLUGGISH WHEN ACCELERATING OR UNDER HIGH LOAD	
Possible cause	**Remedy**
Internal fuel leak between fuel supply pipe(s) and injector(s)	Check the quantity of return fuel
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump

SYMPTOM: WHITE/BLUE SMOKE IS EMITTED	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump
Fault in electrical components/wiring of: - connectors	Check the electrical system

SYMPTOM: BLACK SMOKE IS EMITTED	
Possible cause	**Remedy**
Injector(s) mechanically defective or clogged	Replace the injectors

SYMPTOM: ENGINE OVERHEATED	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel

SYMPTOM: FUEL CONSUMPTION TOO HIGH	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
Leak in fuel system	Check for leaks

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	**Remedy**
Air in fuel system	Check for drawing in of air: - via the suction pipe
Fuel fine filter/coarse filter clogged	Replace the fuel filter and clean the system
Injector(s) mechanically defective or clogged	Replace the injectors
High-pressure pump or fuel lift pump delivery too low	Check: - the high-pressure pump - the fuel lift pump

1

 © **200416**

3. CE ENGINE INLET/EXHAUST SYSTEM

3.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

3.2 FAULT-FINDING TABLE

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	**Remedy**
Air filter element blocked	Replace the air filter element
Turbocharger defective/wastegate control incorrect	Check the turbocharger/wastegate control
Air leak in inlet system	Pressure-test the inlet system

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	**Remedy**
Air filter element partially blocked	Check/replace the air filter element
Air leak in inlet system	Pressure-test the inlet system

SYMPTOM: FUEL CONSUMPTION TOO HIGH	
Possible cause	**Remedy**
Turbocharger defective	Check the turbocharger
Air leak in inlet system	Pressure-test the inlet system

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	**Remedy**
Turbocharger defective	Check the turbocharger

SYMPTOM: RISING AND FALLING TURBOCHARGER SOUNDS	
Possible cause	**Remedy**
Blocked turbocharger air intake	Check air intake and remove any obstacles
Compressor side of turbocharger contaminated	Clean compressor side with a non-corrosive cleaning agent or a soft brush. Check the intake side for carbon deposits or other contamination
Turbocharger damaged	Replace the turbocharger and identify the cause

SYMPTOM: BLACK SMOKE EMERGES FROM EXHAUST	
Possible cause	**Remedy**
Air filter element blocked	Replace the air filter element
Air leakage between turbocharger and inlet manifold	Check flexible pipes and pressurise intake unit
Air leakage between the inlet manifold and cylinder head	Check for leakage. Replace gaskets, if necessary

SYMPTOM: BLACK SMOKE EMERGES FROM EXHAUST	
Possible cause	**Remedy**
Compressor side of turbocharger contaminated	Clean compressor side with a non-corrosive cleaning agent or a soft brush. Check the intake side for carbon deposits or other contamination
Gas leak between the exhaust manifold and the cylinder head	Check the fixing bolts and gaskets
Gas leak between the exhaust manifold and the turbocharger	Check the fixing bolts and gaskets
Turbocharger damaged	Replace the turbocharger and identify the cause

SYMPTOM: BLUE SMOKE EMERGES FROM EXHAUST	
Possible cause	**Remedy**
Air filter element blocked	Replace the air filter element
Air leakage between turbocharger and inlet manifold	Check flexible pipes and pressurise intake unit
Air leakage between the inlet manifold and cylinder head	Check for leakage. Replace gaskets, if necessary
Compressor side of turbocharger contaminated	Clean compressor side with a non-corrosive cleaning agent or a soft brush. Check the intake side for carbon deposits or other contamination
Turbocharger oil discharge pipe clogged	Check oil pipe. Replace as necessary
Turbocharger damaged	Replace the turbocharger and identify the cause

SYMPTOM: OIL LEAK AT TURBINE SIDE OF TURBOCHARGER	
Possible cause	**Remedy**
Compressor side of turbocharger contaminated	Clean compressor side with a non-corrosive cleaning agent or a soft brush. Check the intake side for carbon deposits or other contamination
Turbocharger oil discharge pipe clogged	Check oil pipe. Replace as necessary
Turbocharger damaged	Replace the turbocharger and identify the cause

SYMPTOM: OIL LEAK AT COMPRESSOR SIDE OF TURBOCHARGER	
Possible cause	**Remedy**
Air filter element blocked	Replace the air filter element
Turbocharger oil pipe clogged	Check oil pipe. Replace as necessary
Turbocharger damaged	Replace the turbocharger and identify the cause

1

SYMPTOM: EXHAUST GAS BACK PRESSURE TOO HIGH	
Possible cause	**Remedy**
Incorrect butterfly valve adjustment	Check the adjustment of the butterfly valve
Butterfly valve incorrectly positioned	Check whether the butterfly valve has been positioned correctly
Butterfly valve partially operated by residual pressure in the operating cylinder	Check operating cylinder
Original exhaust silencer not fitted	Check exhaust silencer
Exhaust pipe crushed or internally blocked by a loose part	Check exhaust system for blockage and/or damage

SYMPTOM: INLET UNDERPRESSURE TOO HIGH	
Possible cause	**Remedy**
Air filter element blocked	Replace air filter element

4. ENGINE BRAKE, CE ENGINE

4.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

4.2 FAULT-FINDING TABLE

SYMPTOM: ENGINE BRAKE DOES NOT ENGAGE	
Possible cause	**Remedy**
Compressor delivering insufficient air pressure.	Check the operation of the compressor.
Air leak in the air pipe from air dryer to exhaust brake valve.	Check air pipe.
Butterfly valve stuck in butterfly valve housing.	Check free movement of butterfly valve.
Electrical fault.	Check electrical circuit.

SYMPTOM: ENGINE BRAKE REMAINS ENGAGED	
Possible cause	**Remedy**
Butterfly valve stuck in butterfly valve housing.	Check free movement of butterfly valve.
Electrical fault.	Check electrical circuit.

5. FUEL SYSTEM, XE/PE ENGINE

5.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

5.2 FAULT-FINDING TABLE

SYMPTOM: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
No fuel supply/fuel lift pump defective; no delivery	Check: - the fuel level - the pipes for blockage and leaks - the fuel lift pump - the gallery pressure
Pressure relief valve on pump housing does not shut off	Check the gallery pressure

SYMPTOM: ENGINE STALLS AND RUNS AGAIN AFTER RE-STARTING	
Possible cause	**Remedy**
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Pressure relief valve on pump housing does not shut off	Check the gallery pressure

SYMPTOM: ENGINE STARTS POORLY	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injectors defective	Check the injectors
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure

SYMPTOM: ENGINE RUNS AT (INCREASED) IDLING SPEED AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	**Remedy**
Mechanical defect of accelerator pedal sensor	Check: - mechanical connection of sensor/accelerator pedal - accelerator pedal sensor

SYMPTOM: DIESEL KNOCK DURING ACCELERATION	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Injector defective	Check the injectors

SYMPTOM: IRREGULAR RUNNING OF ENGINE	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure
Pressure relief valve on pump housing does not shut off	Check the gallery pressure

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Mechanical defect of accelerator pedal sensor	Check: - mechanical connection of sensor/accelerator pedal - accelerator pedal sensor

1

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	**Remedy**
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	**Remedy**
Fuel fine filter/coarse filter partially clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Air leak in inlet system	Pressure-test the air inlet system
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure

SYMPTOM: WHITE/BLUE SMOKE IS EMITTED	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure

SYMPTOM: BLACK SMOKE IS EMITTED	
Possible cause	**Remedy**
Injector defective	Check the injectors

SYMPTOM: ENGINE OVERHEATED	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel

SYMPTOM: FUEL CONSUMPTION TOO HIGH	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel fine filter/coarse filter clogged	Replace fuel fine filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Leak in fuel system	Check for leaks

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	**Remedy**
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the seal of the fuel lift pump
Fuel fine filter/coarse filter clogged	Replace the fuel filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace if necessary - the gallery pressure

© 200416

6. XE/PE ENGINE INLET/EXHAUST SYSTEM

6.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

6.2 FAULT-FINDING TABLE

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	**Remedy**
Air filter clogged	Replace or clean the air filter
Turbocharger defective/wastegate control incorrect	Check the turbocharger/wastegate control
Air leak in inlet system	Pressure-test the air inlet system

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	**Remedy**
Air filter partially clogged	Replace or clean the air filter
Air leak in inlet system	Pressure-test the air inlet system

SYMPTOM: FUEL CONSUMPTION TOO HIGH	
Possible cause	**Remedy**
Turbocharger defective	Check turbocharger
Air leak in inlet system	Pressure-test the air inlet system

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	**Remedy**
Turbocharger defective	Check turbocharger

7. ENGINE BRAKE, XE/PE ENGINE

7.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

7.2 FAULT-FINDING TABLE

SYMPTOM: EXHAUST BRAKE DOES NOT ENGAGE	
Possible cause	**Remedy**
Compressor delivers insufficient air pressure	Check the operation of the compressor
Air leak in the air pipe from air dryer to exhaust brake valve	Check air pipe
Butterfly valve stuck in butterfly valve housing	Check free movement of butterfly valve
Electrical fault	Check electrical circuit

SYMPTOM: EXHAUST BRAKE REMAINS ENGAGED	
Possible cause	**Remedy**
Butterfly valve stuck in butterfly valve housing	Check free movement of butterfly valve
Electrical fault	Check electrical circuit

SYMPTOM: DEB DOES NOT ENGAGE	
Possible cause	**Remedy**
Electrical fault	Check electrical circuit
Engine oil pressure too low	Check engine oil pressure

SYMPTOM: DEB REMAINS ENGAGED	
Possible cause	**Remedy**
Electrical fault	Check electrical circuit
Solenoid valve mechanically blocked	Check solenoid valve
Damaged solenoid valve sealing rings	Replace all solenoid valve sealing rings

SYMPTOM: DEB OPERATES IRREGULARLY	
Possible cause	**Remedy**
Electrical fault	Check electrical circuit
Incorrect setting of DEB clearance	Check the DEB clearance
Main piston stuck in DEB housing	Check free movement of main piston
Operating piston stuck in DEB housing	Check free movement of operating piston
Damaged solenoid valve sealing rings	Replace all solenoid valve sealing rings
Solenoid valve oil strainer is blocked	Clean solenoid valve oil strainer
Control valve stuck in DEB housing	Check free movement of control valve
Defective control valve	Check the operation of the control valve
Lubricating oil too thick	Run the engine at operating temperature
Lubricating oil diluted with fuel	Check lubricating oil for dilution

SYMPTOM: DEB OPERATES IRREGULARLY	
Possible cause	**Remedy**
Air bubbles in the oil	Check the engine's oil level/oil specification
Oil duct sealing plugs in DEB housing	Clean/replace sealing plugs

© 200416

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200416
1.1	Safety instructions	1-1	200416
2.	**GENERAL**	2-1	200416
2.1	Location of components	2-1	200416
2.2	System description, ECS-DC3 fuel system	2-7	200416
2.3	Overview drawing, fuel pump	2-9	200416
2.4	Overview drawing, fuel rail	2-10	200416
2.5	Overview drawing, fuel system, cylinder head	2-11	200416
3.	**DESCRIPTION OF COMPONENTS**	3-1	200416
3.1	High-pressure pump	3-1	200416
3.2	Fuel pump control solenoid valve	3-3	200416
3.3	Injector	3-4	200416
3.4	Fuel rail pressure-limiting valve	3-5	200416
3.5	Fuel return overflow valve	3-6	200416
4.	**INSPECTION AND ADJUSTMENT**	4-1	200416
4.1	Inspecting fuel level element	4-1	200416
4.2	Venting the fuel system	4-3	200416
4.3	Checking fuel lift pump pressures	4-5	200416
4.4	Inspection, internal fuel leaks	4-8	200416
4.5	Checking the fuel prefilter/water separator	4-12	200416
5.	**REMOVAL AND INSTALLATION**	5-1	200416
5.1	Removal and installation, injector pipe	5-1	200416
5.2	Removal and installation, fuel supply pipe	5-3	200416
5.3	Removal and installation, injector	5-6	200416
5.4	Removal and installation, fuel rail	5-11	200416
5.5	Removal and installation, fuel rail pressure-limiting valve	5-14	200416
5.6	Removal and installation, high-pressure pump	5-15	200416
5.7	Removal and installation, fuel fine filter	5-17	200416
5.8	Removal and installation, fuel prefilter/water separator filter element	5-18	200416
5.9	Removal and installation, fuel level element	5-20	200416
5.10	Removal and installation, fuel tank filter	5-22	200416
5.11	Removal and installation, electronic unit cooling plate	5-23	200416
5.12	Removal and installation, fuel return overflow valve	5-25	200416
5.13	Removal and installation, low-pressure fuel pipes	5-26	200416
6.	**CLEANING**	6-1	200416
6.1	Cleaning injector	6-1	200416

2

© 200416

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

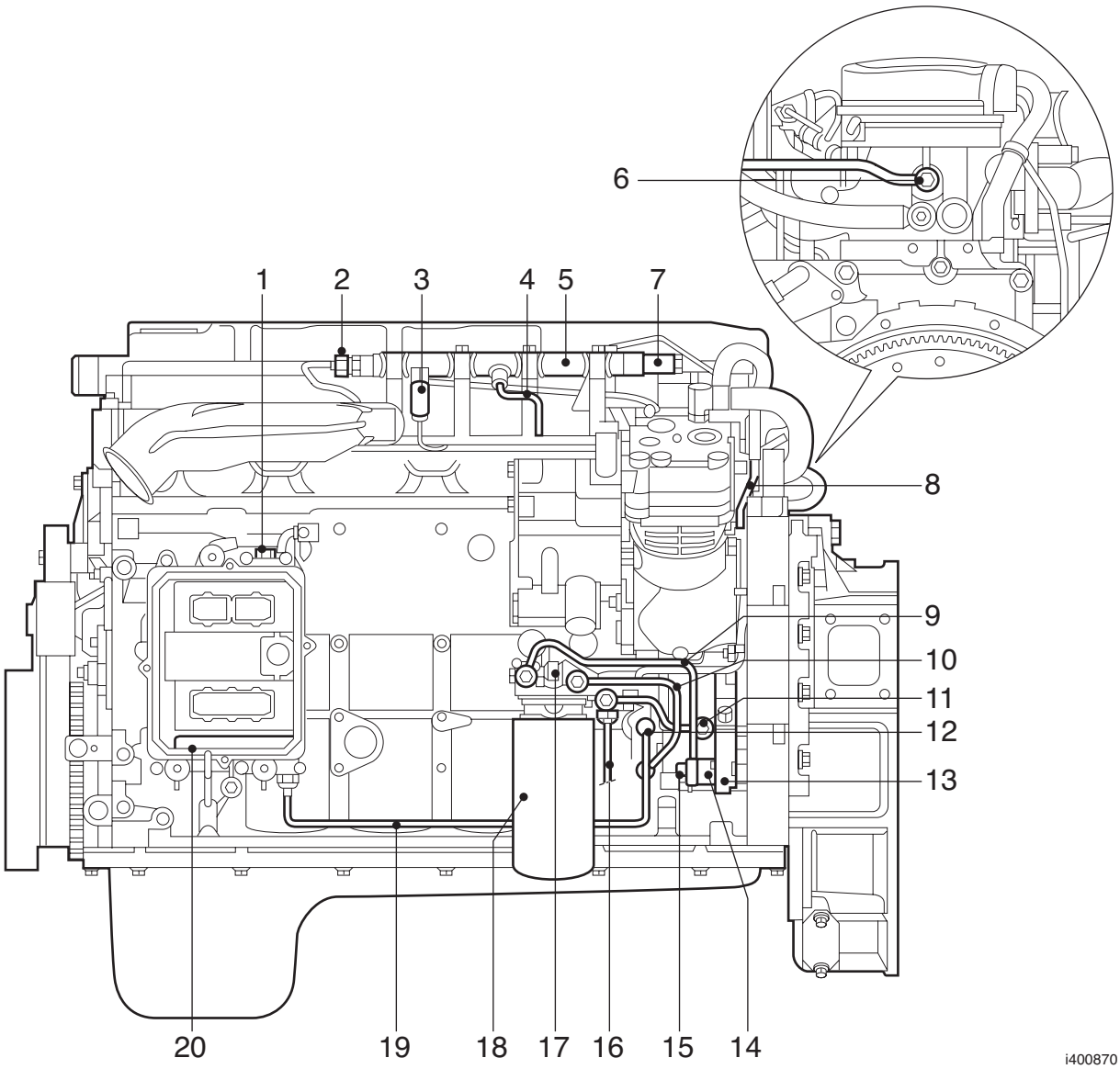
Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

© 200416

2. GENERAL

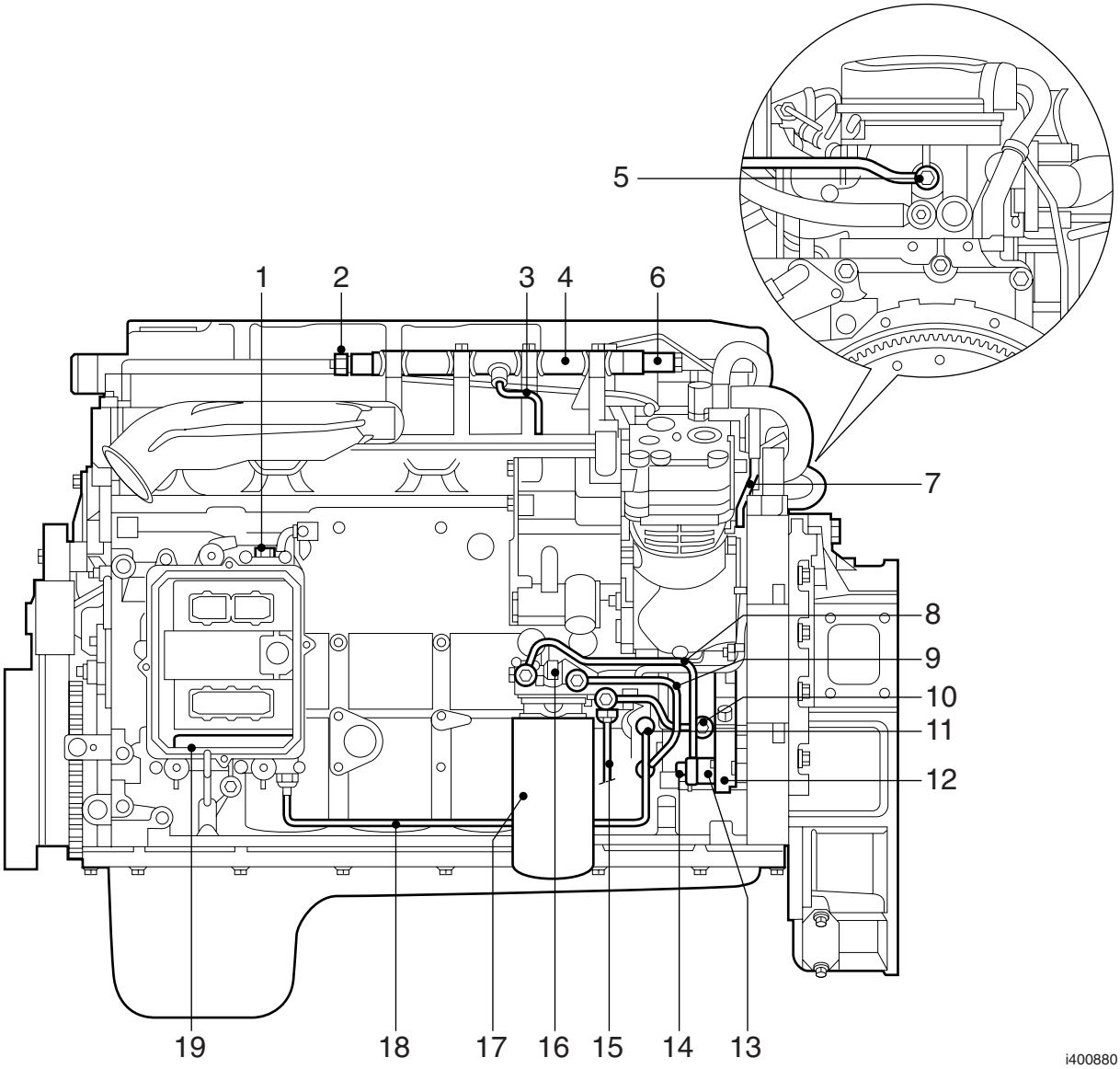
2.1 LOCATION OF COMPONENTS

Location of components, production date < 2003-21 (chassis number < 0E613993)



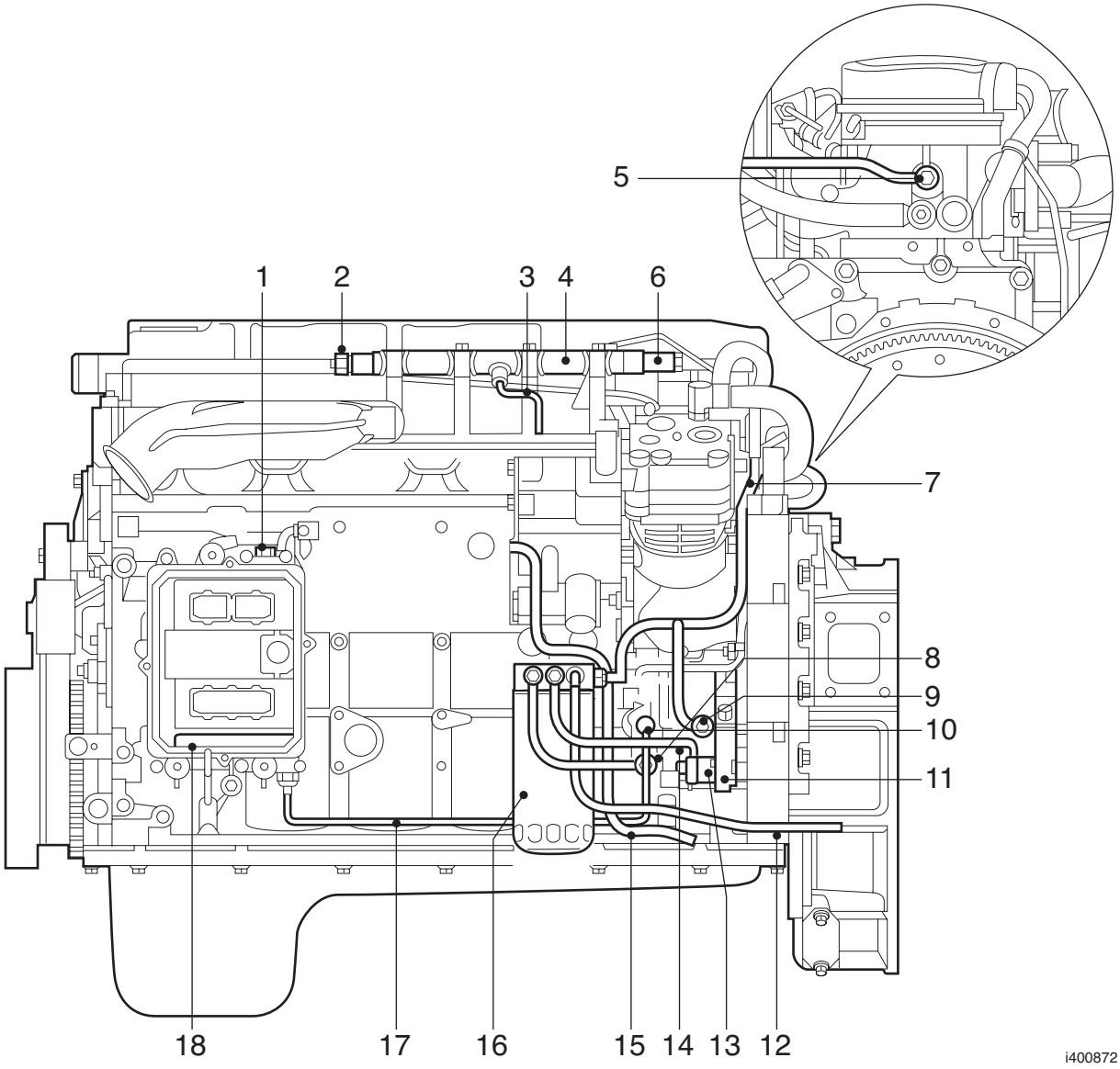
1. Suction pipe to electronic unit cooling plate
2. Injector pipe
3. Fuel rail pressure sensor
4. Fuel pipe to fuel rail
5. Fuel rail
6. Fuel return overflow valve
7. Fuel rail pressure-limiting valve
8. Return pipe from fuel return overflow valve
9. Fuel pipe to high-pressure pump
10. Fuel pipe to fuel fine filter
11. High-pressure pump leak-off pipe
12. Fuel pipe to fuel lift pump
13. High-pressure pump
14. Fuel pump control solenoid valve
15. Fuel pipe to high-pressure pump
16. Return pipe to fuel tank
17. Fuel temperature sensor
18. Fuel fine filter
19. Fuel pipe from electronic unit cooling plate
20. ECS-DC3 electronic unit

Location of components, production date ≥ 2003-21 (chassis number ≥ 0E613993) and production date < 2003-49 (chassis number < 0E628656)



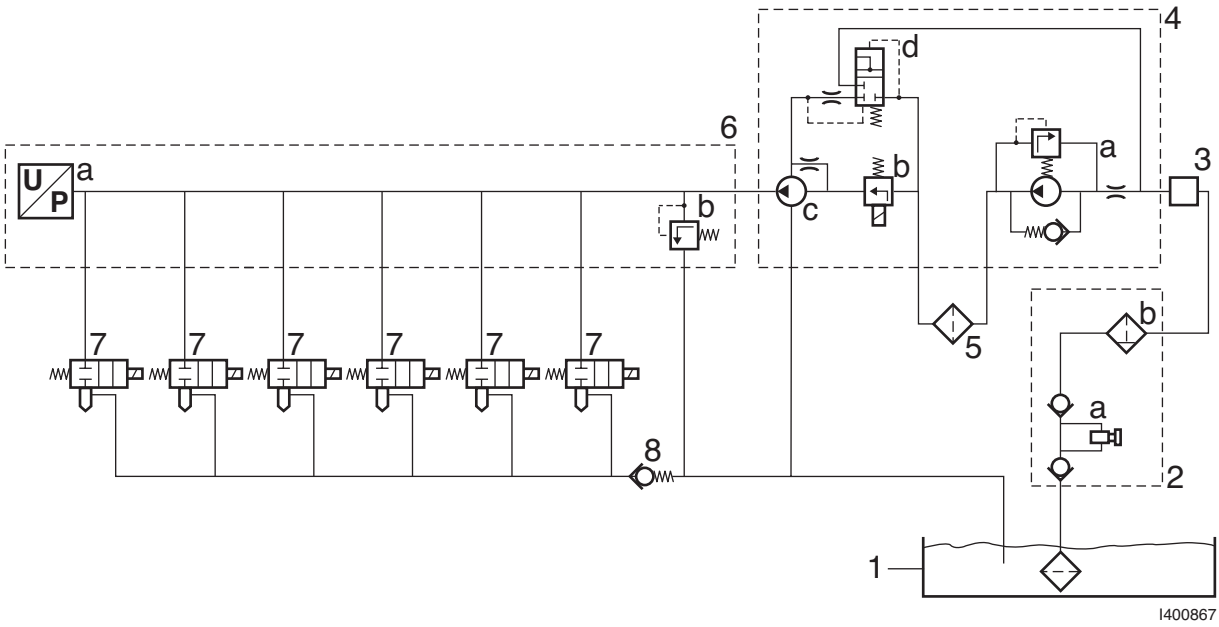
1. Suction pipe to electronic unit cooling plate
2. Fuel rail pressure sensor
3. Fuel pipe to fuel rail
4. Fuel rail
5. Fuel return overflow valve
6. Fuel rail pressure-limiting valve
7. Return pipe from fuel return overflow valve
8. Fuel pipe to high-pressure pump
9. Fuel pipe to fuel fine filter
10. High-pressure pump leak-off pipe
11. Fuel pipe to fuel lift pump
12. High-pressure pump
13. Fuel pump control solenoid valve
14. Fuel pipe to high-pressure pump
15. Return pipe to fuel tank
16. Fuel temperature sensor
17. Fuel fine filter
18. Fuel pipe from electronic unit cooling plate
19. ECS-DC3 electronic unit

Location of components, production date ≥ 2003-49 (chassis number ≥ 0E628656)



1. Suction pipe to electronic unit cooling plate
2. Fuel rail pressure sensor
3. Fuel pipe to fuel rail
4. Fuel rail
5. Fuel return overflow valve
6. Fuel rail pressure-limiting valve
7. Return pipe from fuel return overflow valve
8. Fuel pipe to fuel fine filter
9. High-pressure pump leak-off pipe
10. Fuel pipe to fuel lift pump
11. High-pressure pump
12. Return pipe to fuel tank
13. Fuel pump control solenoid valve
14. Fuel pipe to high-pressure pump
15. Fuel supply pipe
16. Fuel fine filter
17. Fuel pipe from electronic unit cooling plate
18. ECS-DC3 electronic unit

2.2 SYSTEM DESCRIPTION, ECS-DC3 FUEL SYSTEM



The fuel lift pump (4a) draws the fuel from the fuel tank (1) through the cooling plate of the electronic unit (3).
The purpose of the cooling plate (3) is to ensure that the electronic unit does not become too hot.
The fuel lift pump (4a) is fitted against the high-pressure pump (4c) and is driven by the camshaft gear.
From the fuel lift pump, fuel is forced towards the fuel fine filter (5).

After the filter, the fuel enters the high-pressure pump (4c) via the fuel pump control solenoid valve (4b), which controls the amount of fuel going to the high-pressure pump. Fuel not taken in by the high-pressure pump returns via the by-pass valve (4d) to the fuel lift pump supply pipe and part of it is used for lubricating the high-pressure pump.

The high-pressure pump forces the fuel under high pressure to the fuel rail (6). The fuel rail distributes the fuel among the injectors (7). The fuel rail (6) also functions as an accumulator to ensure that large fluctuations in pressure, resulting from injector openings and pump pressure pulses, are prevented as much as possible.

The pressure in the fuel rail is registered by the rail pressure sensor (6a). The electronic unit uses this data to control the high-pressure pump (via the fuel pump control solenoid valve), so that the rail pressure can be kept at the desired level. The desired pressure is not constant, but depends on the operating conditions.

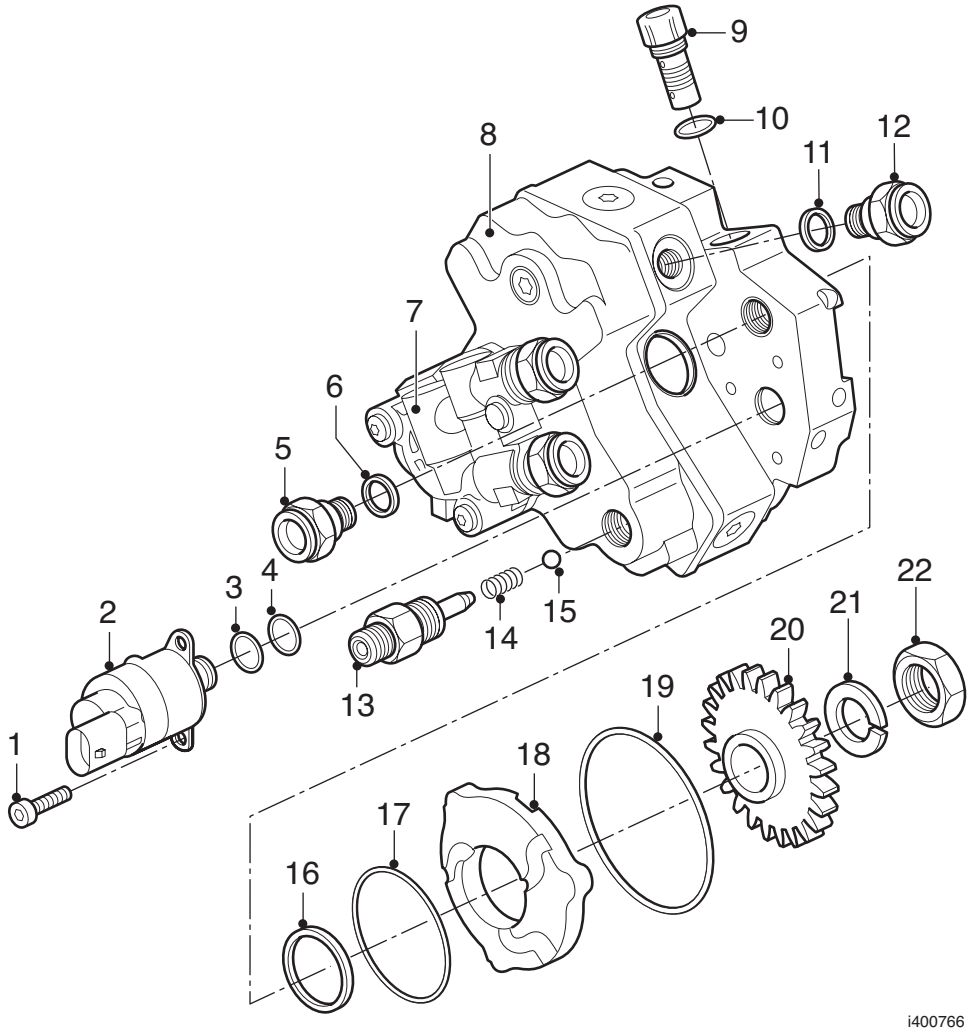
A pressure relief valve (6b) is fitted at the end of the fuel rail. If the pressure in the fuel rail rises too high (in emergencies only), this valve ensures that the excess fuel flows back to the return pipe. The return pipe is connected with the return pipe to the fuel tank (1).

The electronic unit uses the present rail pressure to calculate the time during which the injector needs to be opened in order to obtain the desired injection quantity.

A pressure relief valve (8) connects the injector leak-off ducts in the cylinder head with the return pipe to the fuel tank (1). This pressure relief valve prevents the fuel from flowing out of the injectors when the engine has stopped running.

If the system has been "open", the fuel system can be bled using the primer pump (2a), which is integrated in the water separator/coarse filter (2b).

2.3 OVERVIEW DRAWING, FUEL PUMP

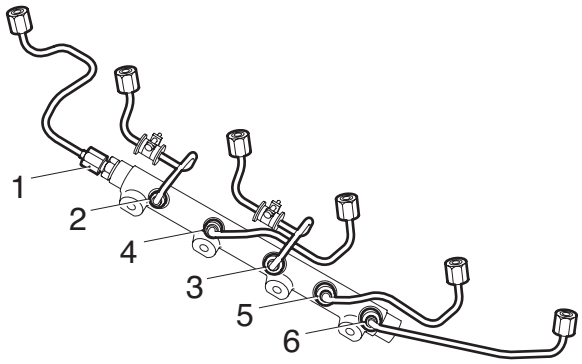


i400766

1. Attachment bolt
2. Fuel pump control solenoid valve
3. O-ring
4. O-ring
5. Fuel pipe connection
6. Copper ring
7. Lift pump
8. High-pressure pump
9. Circulation valve
10. O-ring
11. Copper ring
12. Fuel pipe connection
13. High-pressure pipe connection
14. Spring
15. Ball
16. Oil seal
17. O-ring
18. Adapter ring
19. O-ring
20. Gear wheel
21. Sealing ring
22. Nut

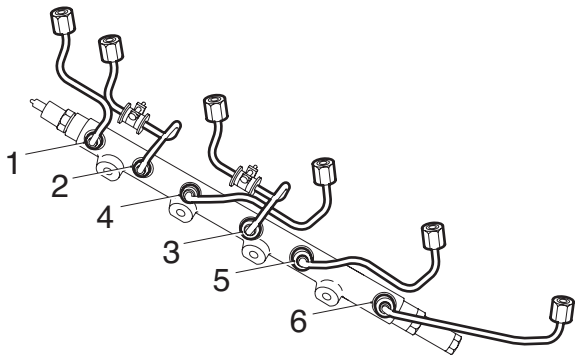
2.4 OVERVIEW DRAWING, FUEL RAIL

Overview drawing, fuel rail, production date < 2003-21 (chassis number < 0E613993)
The figure shows the connections to the injector pipes. The numbers indicate the cylinder number of the connection.



i400765

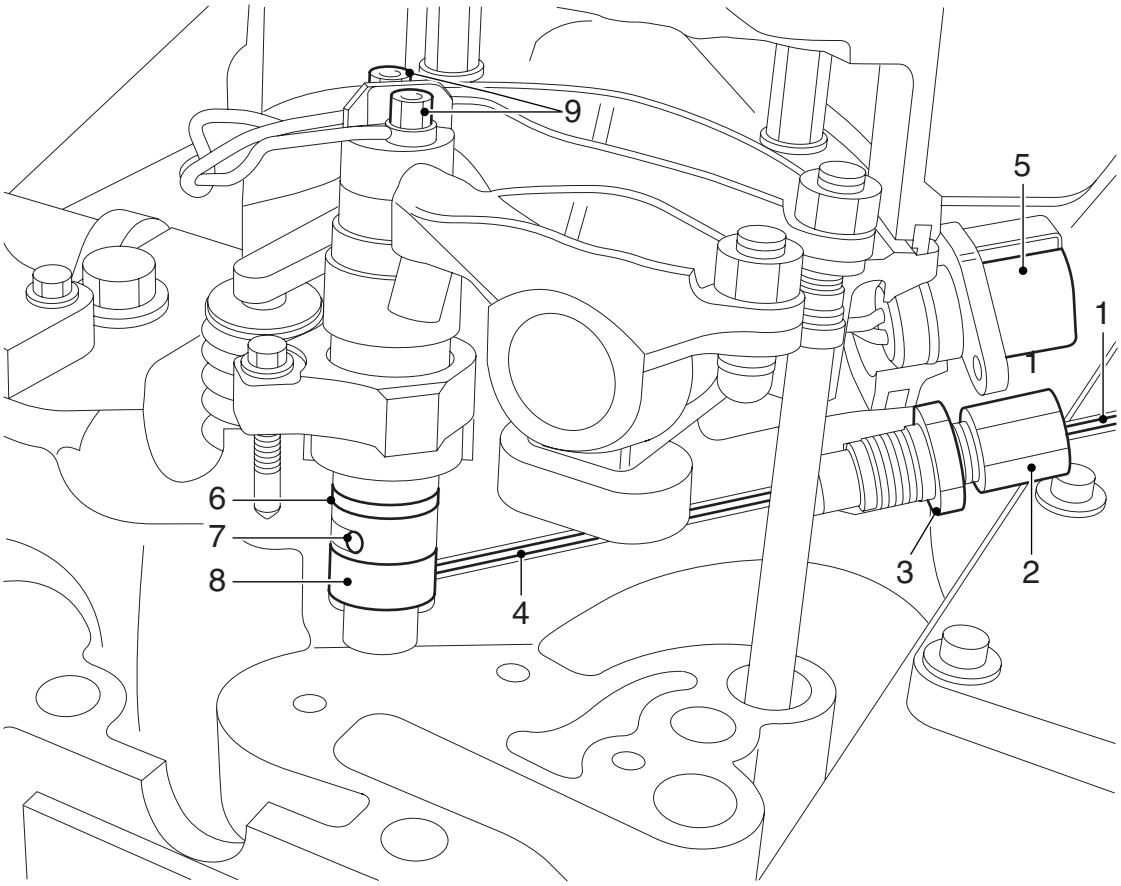
Overview drawing, fuel rail, ≥ production date 2003-21 (chassis number ≥ 0E613993)
The figure shows the connections to the injector pipes. The numbers indicate the cylinder number of the connection.



i400874

2

2.5 OVERVIEW DRAWING, FUEL SYSTEM, CYLINDER HEAD



1. Injector pipe
2. Union
3. Nut
4. Fuel supply pipe
5. Connector to injectors
6. O-ring
7. Return opening
8. Injector
9. Electrical connection

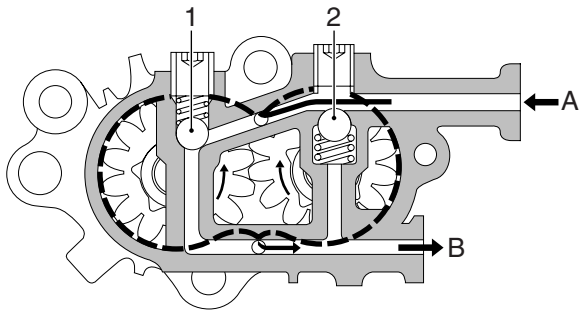
2

© 200416

3. DESCRIPTION OF COMPONENTS

3.1 HIGH-PRESSURE PUMP

The high-pressure pump is driven by the crankshaft by means of the camshaft gear. The pump shaft rotates at a speed 1.33 times the speed of the crankshaft. The pump shaft drives the fuel lift pump. The fuel drawn from the suction side by the gears is discharged through the exit by the gears due to the reduction in volume. The fuel lift pump has two added valves. The first valve (1) limits the pump pressure, for example if the fine filter is blocked. The second valve (2) opens the by-pass over the fuel lift pump when the primer pump is being used.

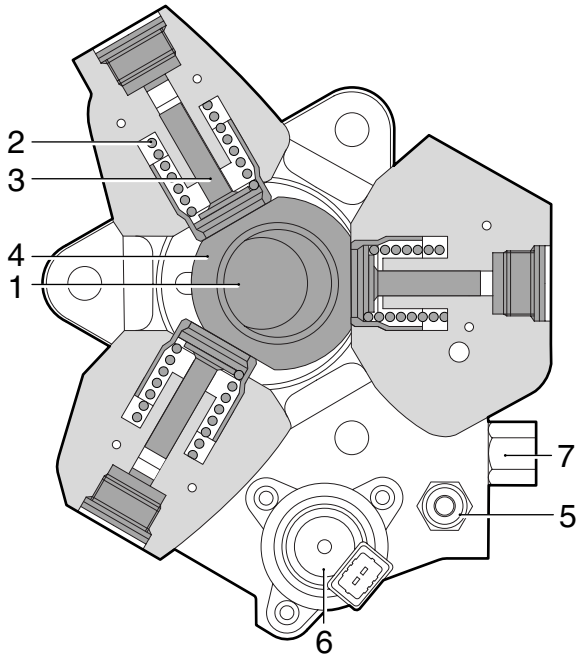


i400595

The high-pressure pump shaft (1) has an eccentric. The eccentric drives the eccentric ring (4). The pump plungers (3) are driven by the eccentric ring and pushed back by the spring (2).

The fuel is supplied via the connection (5) and then internally distributed among the three pump elements. Before it is distributed among the pump elements, the supplied fuel is dosed by means of the fuel pump control solenoid valve (6).

The fuel pump control solenoid valve is controlled by the electronic unit on the basis of the rail pressure sensor signal. This creates a closed control circuit. The fuel pump control solenoid valve is "normally open" and is activated via duty cycle control. The value when the engine is started is fixed. When the measured pressure deviates from the desired (programmed) pressure, the duty cycle value will be adapted until the measured and the desired values correspond. If this is impossible, the electronic unit will generate a warning and record a fault code.



i400589

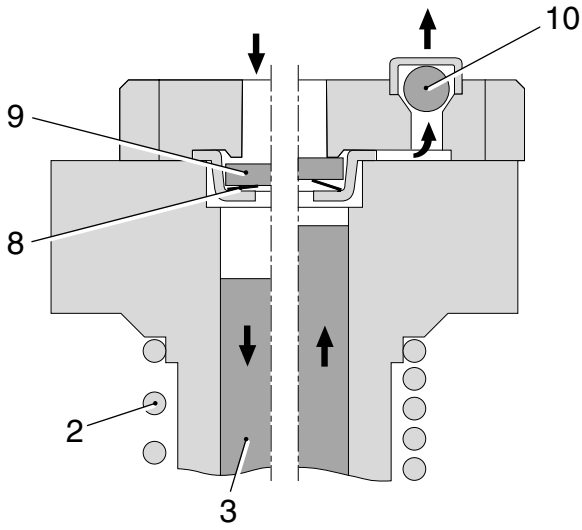
2

During the downward stroke, the fuel is supplied by the fuel lift pump via the suction valve (9) (see illustration on left). During the delivery stroke (illustration on right), the suction valve closes under the load of the spring (8) and the fuel pressure that has built up. The fuel leaves the pump element via the delivery valve (10). The compressed fuel from the three pump elements is collected in the pump housing and leaves the pump via a joint high-pressure connection.

Leaking fuel from the pump elements is discharged via the return connection.

The fuel lift pump has over-capacity in relation to the high-pressure pump. If there is only limited fuel off-take on the rail, the fuel pump control solenoid valve will be virtually closed. The over-supplied fuel will cause an increase in pressure at the inlet of the fuel pump control solenoid valve. The pressure is limited by the circulation valve (7). If the valve is open, the excess supplied fuel will be returned to the suction side of the fuel lift pump. A small amount of fuel is diverted via a restriction to the shaft and the eccentric of the high-pressure pump for lubrication.

When bleeding with the primer pump, any air bubbles will be carried along by the fuel through the low-pressure circuit. Fuel is forced inwards at the connection (5). The fuel pump control solenoid valve is opened fully without being energised, so that the fuel can pass. The pump elements create a high resistance to the fuel, so that the fuel will escape via the lubricating restriction in the pump. In this way the fuel, along with any air bubbles, is discharged to the return pipe.



i400590

3.2 FUEL PUMP CONTROL SOLENOID VALVE

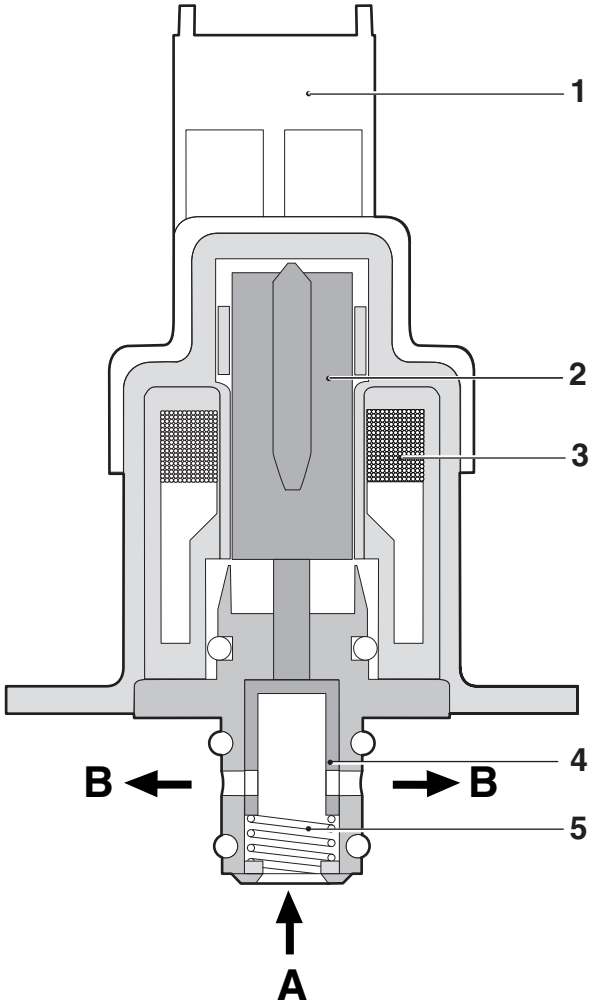
The high-pressure pump has an over-capacity for normal operating conditions. This could lead to large quantities of fuel being forced at high pressure to the fuel rail and then directly being drained out to the return pipe via the pressure-limiting valve on the fuel rail. This produces too much unnecessary heat and loss of capacity because large amounts of fuel are flowing at high pressure.

The system has been designed such that only fuel that will be used will be forced under high pressure to the rail. For this reason, a fuel pump control solenoid valve has been fitted at the suction side of the high-pressure pump. This solenoid valve is opened without being energised, so that the high-pressure pump elements can be filled in the normal manner.

If the fuel rail pressure becomes too high, for example because of lower fuel off-take on the rail, the solenoid valve will be energised by the electronic unit with a higher duty cycle, so that the plunger is pressed with a greater force against the spring pressure and the valve reveals a more constricted opening. This reduces the fuel supply to the pump elements and the pump output will thus fall. The fuel rail pressure will also fall as a consequence.
If the rail pressure is too low, the reverse is true.

The current is supplied to the coil (3) via the connector (1). The current pushes the core (2) with the plunger (4) against the pressure of the spring (5). This controls the fuel current from input A to output B.

Due to this valve, under normal circumstances very little fuel flows back from the rail. This improves performance and reduces the generation of heat.



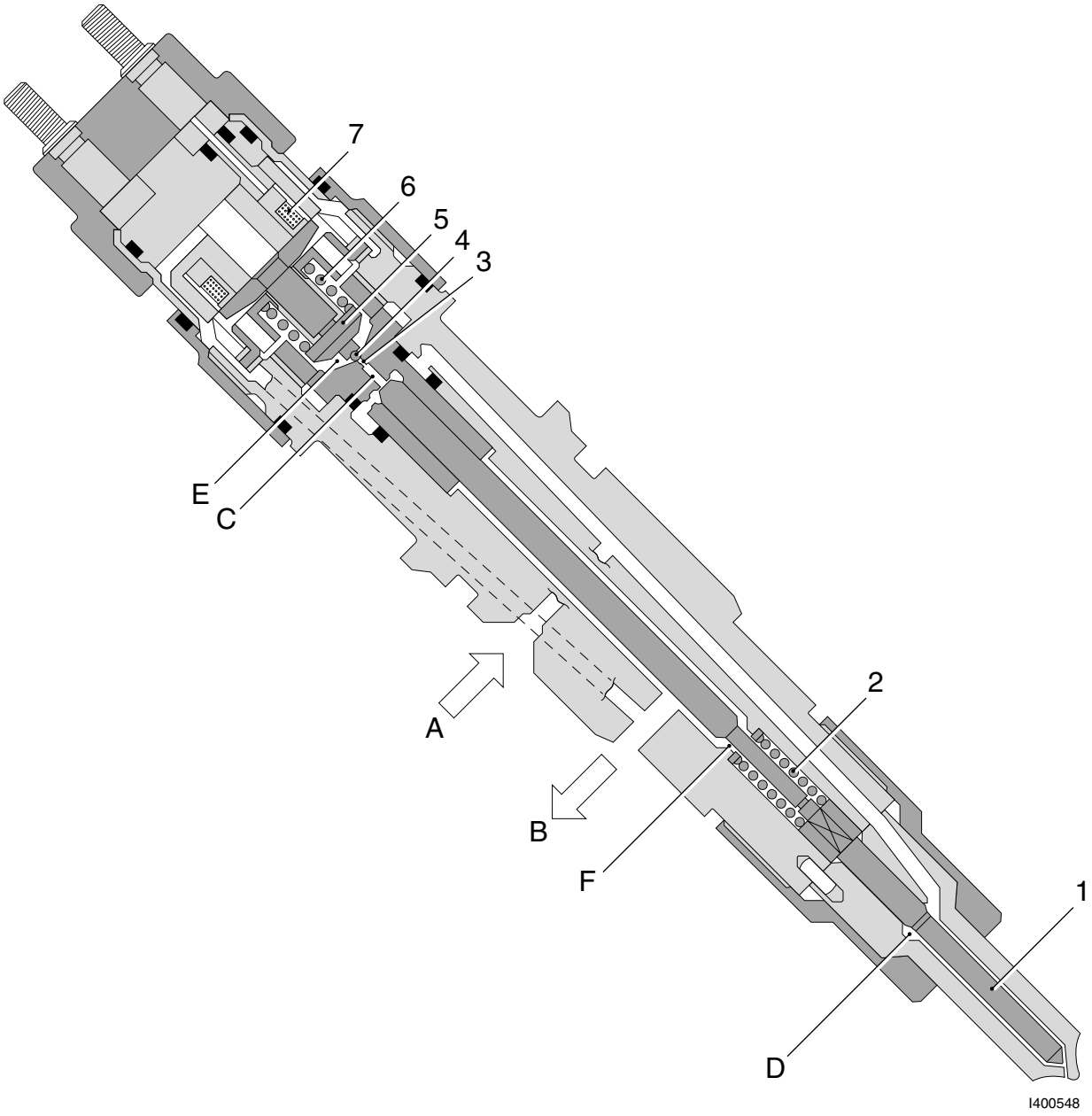
i400591

3.3 INJECTOR

The injectors can be opened and closed electrically. The injector is normally closed. The load of the spring (2) and the fuel rail pressure that controls chamber C ensure this.

The fuel is supplied from the fuel rail via A. The return fuel can flow back to the fuel tank via B.

When the coil (7) is energised, the armature housing (5) moves up. As a result the pressure in chamber C drops slightly and the injector needle (1) is forced up to chamber D by the rail pressure. The fuel can then be injected.

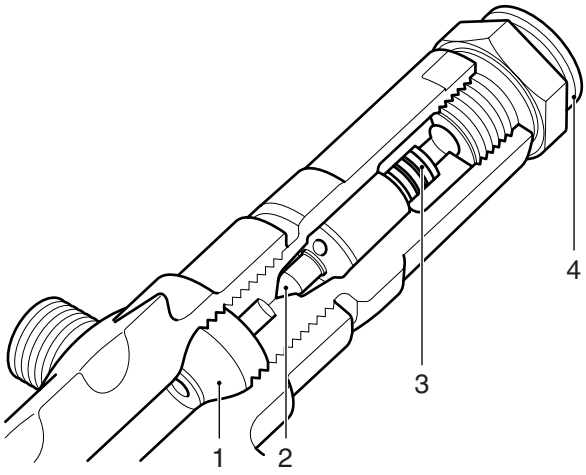


3.4 FUEL RAIL PRESSURE-LIMITING VALVE

The fuel rail has a pressure-limiting valve so that the rail pressure is maintained at a safe value in emergency situations.

The fuel rail pressure control circuit is normally active. This consists of the fuel lift pump, fuel pump control solenoid valve, high-pressure pump, fuel rail, rail pressure sensor and electronic unit. If a fault occurs, the rail pressure can no longer be controlled. This can rise to the actuating pressure of the fuel rail pressure-limiting valve. This pressure is approx. 1650 bar. In the open position all surplus fuel flows without pressure to the fuel tank return connection.

The valve includes a sealing cone (1), a valve body (2), a spring (3) and a return connection with quick-release coupling (4).

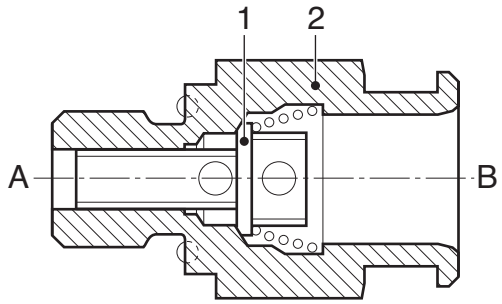


i400592

3.5 FUEL RETURN OVERFLOW VALVE

The injectors are mounted in the cylinder head. The injectors do not have a separate return connection. In place of this there is a longitudinal bore in the cylinder head that meets the injector bores of all cylinders coinciding with the height of the return ports of the injectors. A pressure relief valve is mounted at the end of the bore to prevent vapour bubbles forming in it and to prevent it emptying after the engine is turned off. This valve maintains a residual pressure in relation to the return pressure of 1.2 to 2.0 bar.

The pressure relief valve consists of a spring-loaded plunger (1) and a housing (2) with quick-release inlet and outlet connections (A and B respectively).



i400861

4. INSPECTION AND ADJUSTMENT

4.1 INSPECTING FUEL LEVEL ELEMENT

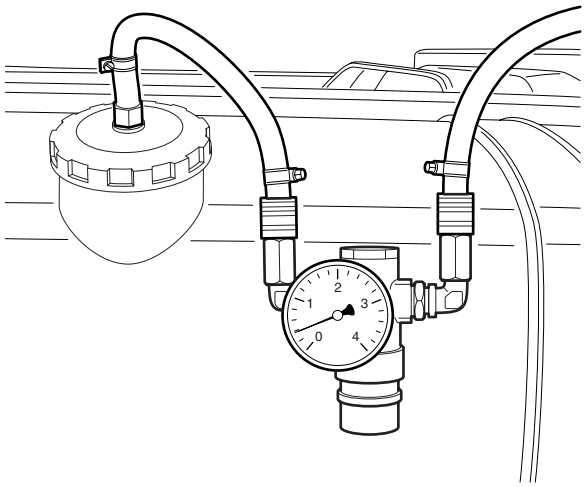
To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

Note:
To prevent dirt from entering, first clean the exterior of the fuel tank.

1. Fit a pressure reducer valve connection on a fuel-tank cap (without bleed vent) and connect the cap to the fuel tank.

2. Slowly increase the pressure until the system audibly blows off via the pressure relief valve and check the opening pressure of the fuel level element. See "Technical data".

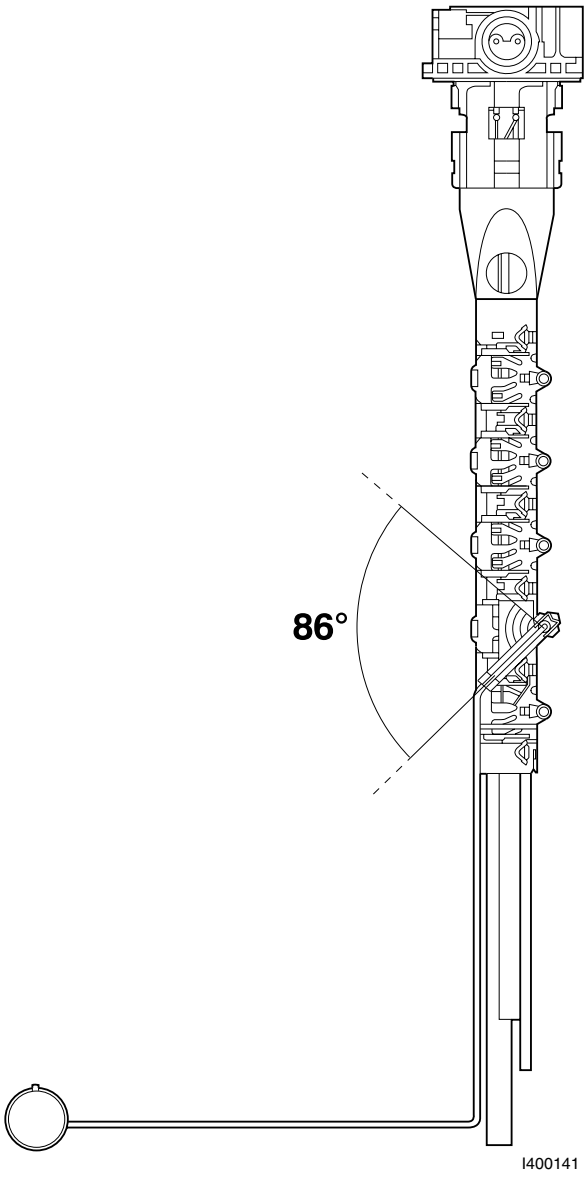
3. De-pressurise the fuel tank and remove the tank cap with the air connection.



i400600

4. Remove the fuel level element.

5. Check the angular displacement of the fuel level element and the resistance value. See "Technical data".



4.2 VENTING THE FUEL SYSTEM

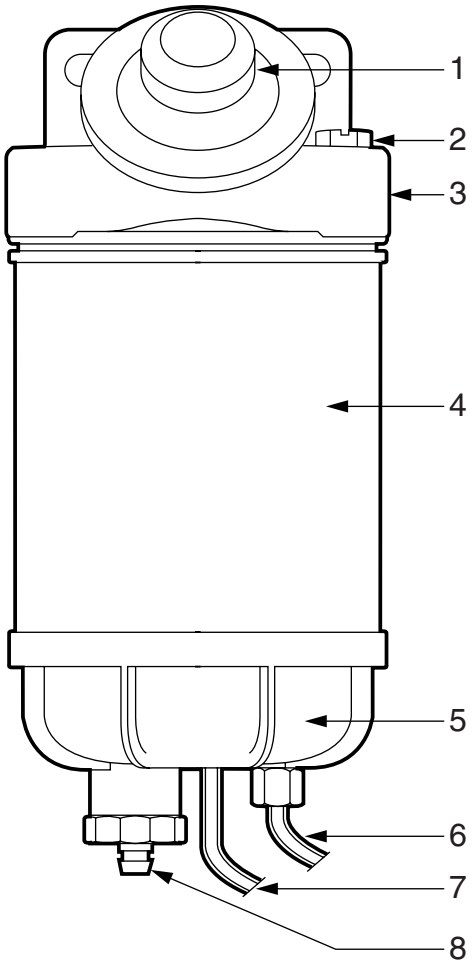
When venting the fuel system, a quantity of fuel will escape. Collect the fuel and avoid the risk of fire.

Stop pumping as soon as a resistance is felt. If you continue pumping, the fuel system may become internally damaged.

Note:
When the primer pump is used, the fuel system will be automatically vented. Air will be fed back to the tank through the return line.

Racor fuel prefilter/water separator

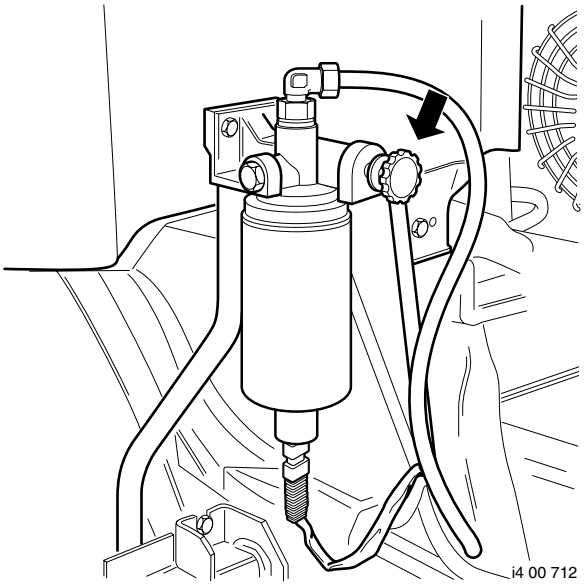
1. Open the vent plug (2) a couple of turns.
2. Pump the primer pump (1) until fuel comes out of the vent plug (2).
3. Close the vent plug (2).
4. Use the primer pump until a clearly higher resistance is felt.



i400356

Fleetguard fuel prefilter/water separator

1. Unscrew the button of the primer pump and pull it out.
2. Use the primer pump until a clearly higher resistance is perceptible.
3. Hand-tighten the button.



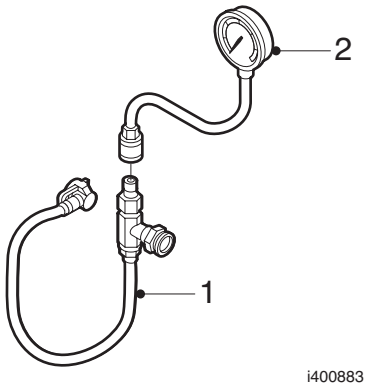
4.3 CHECKING FUEL LIFT PUMP PRESSURES

When inspecting the fuel pressure, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Checking underpressure on suction side of fuel lift pump

1. Disconnect the fuel pipe from the electronic unit cooling plate to the fuel lift pump on the suction side of the fuel lift pump; see "Removal and installation".
2. Fit the adapter (1), special tool (DAF no. 1329476), between the pipe which has been removed and the fuel lift pump and couple a pressure gauge (2) to this adapter.
3. Bleed the fuel system.
4. Measure the underpressure when the engine is idling. Compare the readings with the specified values. See "Technical data".
5. Remove the pressure gauge and the adapter and fit the fuel pipe.
6. Bleed the fuel system, start the engine and check the fuel system visually for leaks if no further measurements are to be carried out.



i400883

Checking fuel pressure in fuel lift pump in front of fuel fine filter

1. Disconnect the fuel pipe from the lift pump to the fuel fine filter on the delivery side of the lift pump; see "Removal and installation".

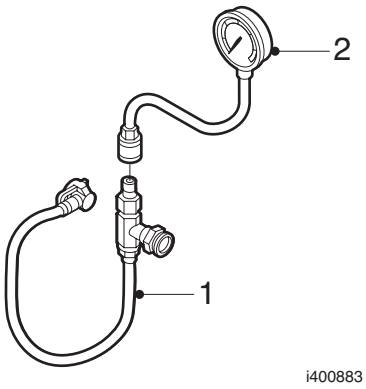
2. Fit the adapter (1), special tool (DAF no. 1329476), between the pipe which has been removed and the fuel lift pump and couple a pressure gauge (2) to this adapter.

3. Bleed the fuel system.

4. Start the engine and measure the pressure when the engine is idling. Compare the readings with the specified values. See "Technical data".

5. Remove the pressure gauge and the adapter and fit the fuel pipe.

6. Bleed the fuel system, start the engine and check the fuel system visually for leaks if no further measurements are to be carried out.



i400883

Checking fuel pressure in fuel lift pump after fuel fine filter

1. Disconnect the fuel pipe from the fuel fine filter to the high-pressure pump on the side of the high-pressure pump; see "Removal and installation".

2. Fit the adapter (1), special tool (DAF no. 1329476), between the pipe which has been removed and the high-pressure pump and couple a pressure gauge (2) to this adapter.

3. Bleed the fuel system.

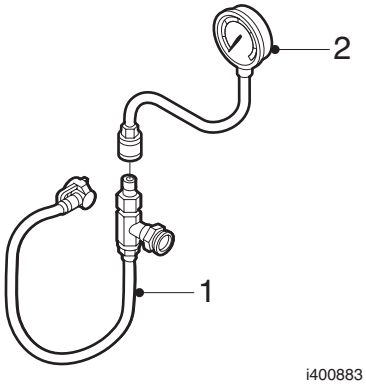
4. Disconnect the electrical connectors of the injectors from the valve sleeve.

5. Start the engine and measure the pressure when the engine is idling. Compare the readings with the specified values. See "Technical data".

6. Connect the electrical connectors of the injectors to the valve sleeve.

7. Remove the pressure gauge and the adapter and reconnect the fuel pipe.

8. Bleed the fuel system, start the engine and check the fuel system visually for leaks if no further measurements are to be carried out.



i400883

Check pressure drop across fuel fine filter

1. Check the fuel pressure in front of the fuel fine filter.

2. Check the fuel pressure after the fuel fine filter at maximum engine speed.

3. Compare the measured pressure drop across the fuel fine filter with the specified value. See "Technical data". If the pressure drop is too great, the fuel fine filter must be replaced.

4.4 INSPECTION, INTERNAL FUEL LEAKS

When inspecting for internal fuel leaks, fuel will escape. Collect the fuel and avoid the risk of fire.

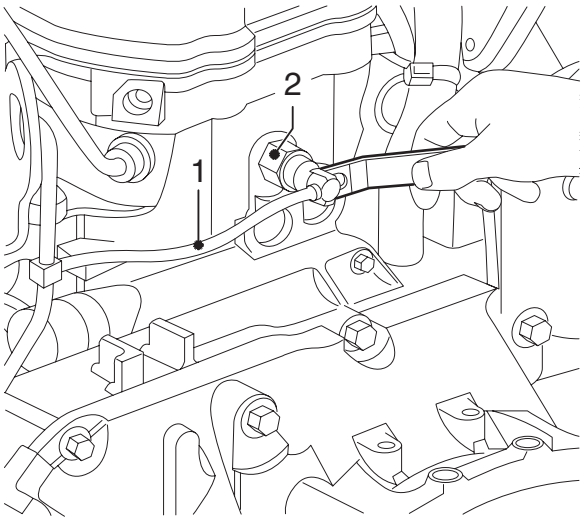
Dirt in the fuel system can lead to significant damage to parts of the system. All open connections must therefore be sealed.

The common rail system is under high pressure when the engine is running. This pressure can rise to approx. 1400 bar. Even when the engine is not running, there may be a high residual pressure in the fuel rail (approx. 50 bar). Depressurise the system before working on the common rail system by wrapping the coupling in a cloth and then unscrewing it and collecting the escaping fuel in a container.

Inspection, internal fuel leaks

1. Check that all injector pipes have been tightened to the correct torque and that there are no external signs of fuel leakage; see "Technical data".

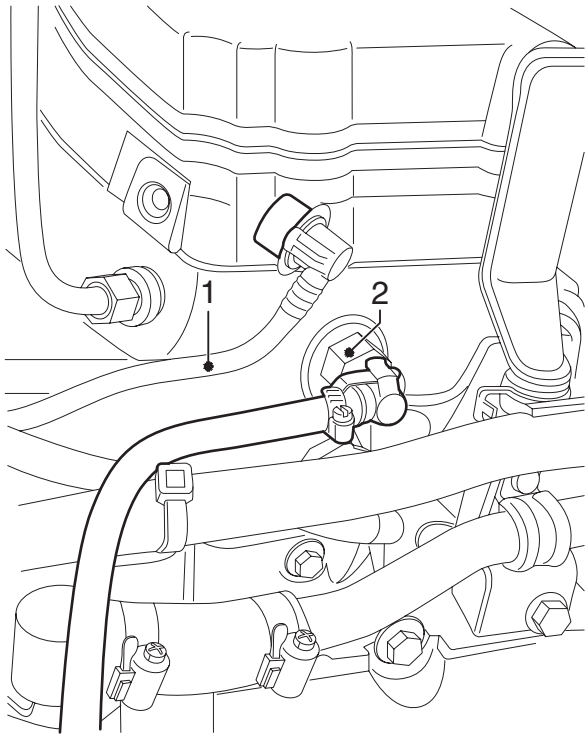
2. Disconnect the fuel return pipe (1) from the fuel return overflow valve (2) on the rear of the cylinder head.



i400679

3. Seal the disconnected fuel pipe (1) using the special tool (DAF no. 1453151) to prevent the return fuel escaping.

4. Fit the special tool (DAF no. 1329476) onto the fuel return overflow valve (2).

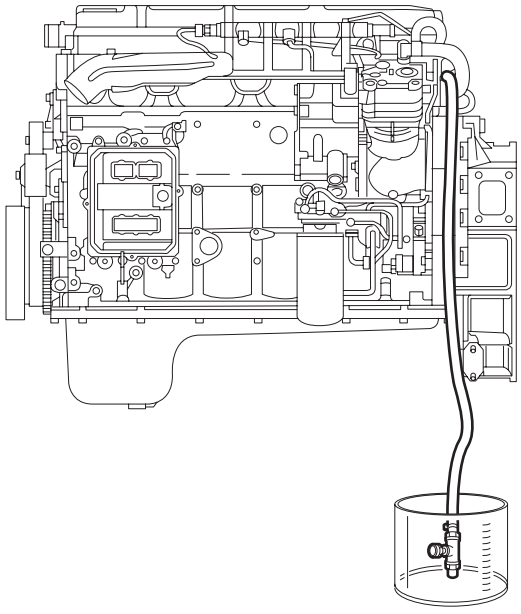


i400680

5. Place the free end of the special tool (DAF no. 1329476) in a container and start the engine.

6. While the engine is idling, measure the quantity of return fuel using a stop watch and a measuring beaker; see "Technical data" for the maximum quantity of return fuel.

   Note:
   If the quantity of return fuel is within the specified value there are no internal leaks. If the quantity of return fuel exceeds the specified value, the internal fuel leak must be located.


i400682

Locating internal fuel leak

1. Take the injector pipe out of cylinder 1.

2. Seal the connection of cylinder 1 on the fuel rail using the special tool (DAF no. 1453133). Tighten the plug to 30 Nm.

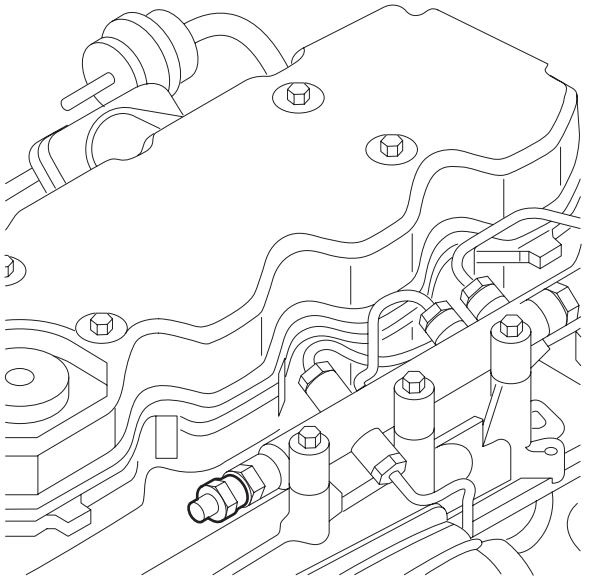
3. While the engine is idling, use a stop watch to measure the time required to fill a measuring beaker with 360 ml of return fuel. See "Technical data" for the minimum time permitted for filling the measuring beaker.

   Note:
   Use a measuring beaker with a mark at 360ml.

4. Remove the special tool (DAF no. 1453133) and reconnect the injector pipe.

5. Repeat the above steps for the other cylinders and note the values.

   Note:
   When the leaking cylinder has been plugged, the quantity of return fuel will decrease and, as a result, the time it takes to fill the measuring beaker to 360ml will increase.
   If several high values are measured, this indicates that there may be several leaks. If this is the case, first check the cylinders that give the highest values and then repeat the test.
   In the example shown in the table below there is an internal leak in the 5rd cylinder, which could be caused by a leak in the fuel supply pipe and/or a defective injector.


i400681

Example:

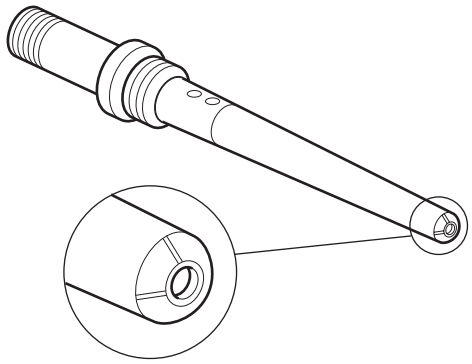
Leak test results						
Blocked cylinder	1	2	3	4	5	6
Time (s) to fill to 360ml	35	36	35	37	150	38

6. In the event of a leak, remove the fuel supply pipe and the injector of the cylinder in question; see "Removal and installation".

7. Check the fuel supply pipe for damage and signs of leakage.
   Leakage in the fuel supply pipe can be recognised by erosion tracks (lines) on the nose of the supply pipe. If necessary or if in doubt, replace the fuel supply pipe.

8. Check that the injector fuel connection is not leaking.
   Leakage in the injector fuel connection can be recognised by erosion tracks (lines) in the socket of the fuel connection . If necessary or if in doubt, replace the injector.

   Note:
   If fuel has been found in the lubricating oil, extra attention must be paid to the O-rings of the injectors, as these have most probably been damaged by increased pressure in the return circuit as a result of an internal leak.


i400776

Note:
The following guidelines must be adhered to:
- If the injector is defective, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and in addition the sealing surface with the injector is damaged, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and the sealing surface with the injector is not damaged, the fuel supply pipe must be replaced but the injector can be reused.

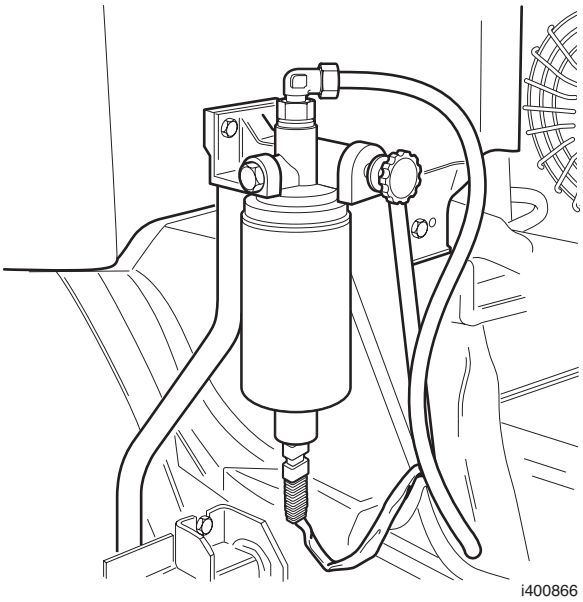
9. Fit the injector and fuel supply pipe. See "Removal and installation".

10. Again inspect for internal fuel leaks to check that there is no leakage.

4.5 CHECKING THE FUEL PREFILTER/WATER SEPARATOR

If a fuel prefilter/water separator is fitted, there are two versions.

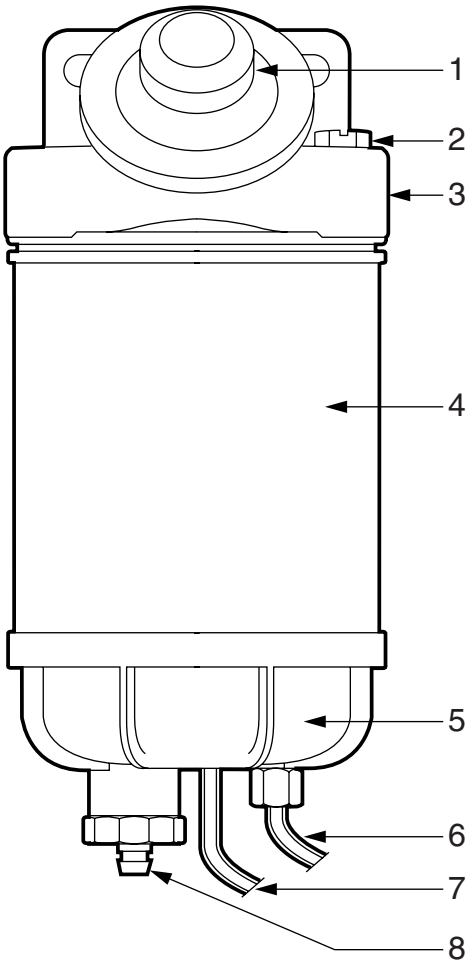
Note:
The "Fleetguard" version cannot be visually inspected for water.


i400866

"Racor" version

1. Check the reservoir (5) for water.

2. If necessary, drain the water off through the drain plug (8) using the fuel lift pump (1) and collect the water and fuel in a container.



i400356

2

© 200416

5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, INJECTOR PIPE

Never bend injector pipes as they may kink or crack.
The injector pipes form part of the high-pressure section of the fuel system. When the unions are unscrewed, fuel under high pressure may escape. Take measures to prevent fire and injury. Collect the escaping fuel in a suitable container.

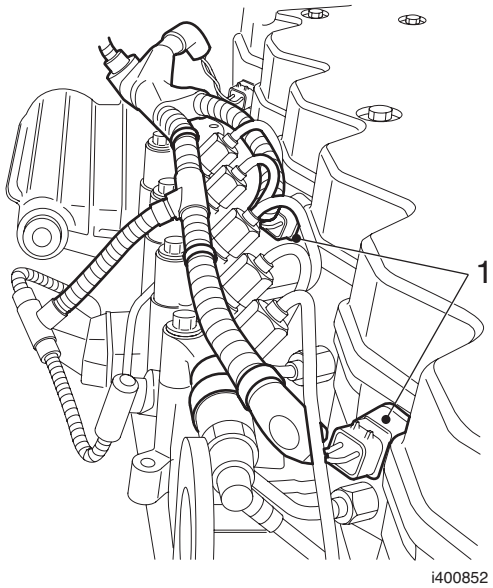
Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Note:
Codes (1) are stamped in the injector pipe unions to enable correct positioning. The first figure is the number of cylinders of the engine followed by the fitting position.

Removing the injector pipe

1. Clean the area surrounding the unions, both near the injectors and near the fuel rail.

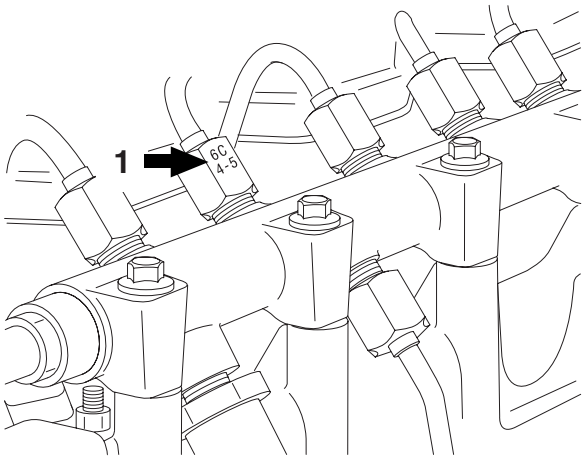
2. Remove the connectors (1) of the injectors from the valve sleeve.



Note:
Note the sequence in which the injector pipes are removed. They should be re-fitted in precisely the reverse order.

3. Unscrew the unions on both sides of the pipe and remove the pipes.

4. Immediately plug the openings.



i400482

Installing the injector pipe
1. Clean the injector pipe and blow-clean it with dry compressed air.

2. Fit the injector pipes in reverse order and hand-tighten the unions. When all the pipes and unions are correctly fitted, the unions must be tightened to the specified torque. See "Technical data".

3. Fit the connectors of the injectors in the valve sleeve.

4. Start the engine to bleed the high-pressure section of the fuel system and inspect all fuel pipes for leaks.

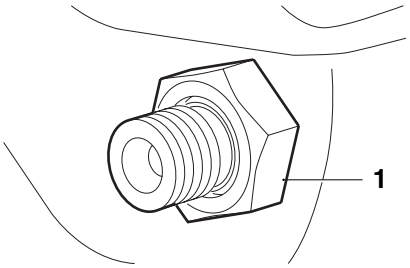
5.2 REMOVAL AND INSTALLATION, FUEL SUPPLY PIPE

When removing a fuel pipe, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. All open connections must therefore be sealed.

Removing the fuel supply pipe

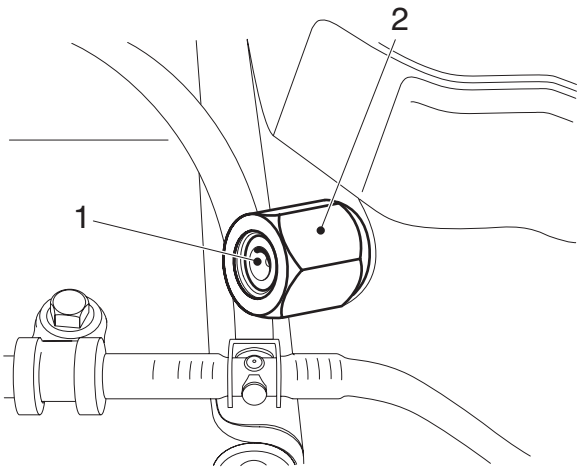
1. Disconnect the injector pipes.
2. If necessary, remove the fuel rail.
3. Remove the nut (1) from the fuel supply pipe.



i400486

4. Mark the positions of the fuel supply pipe (1) and pull it out of the cylinder head with special tool (DAF no. 1329473) (2).

   Note:
   If the injector is **not** replaced, the fuel supply pipe may be re-used provided it is fitted with the original injector.



i400823

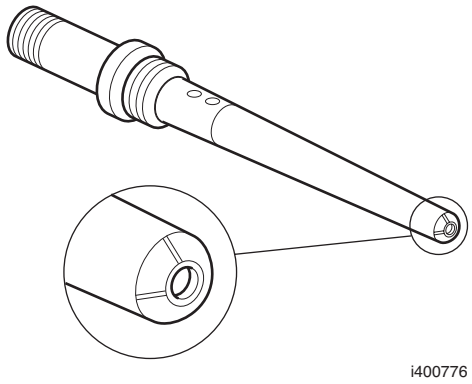
Installing the fuel supply pipe

The following guidelines must be adhered to:

- If the injector is defective, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and in addition the sealing surface with the injector is damaged, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and the sealing surface with the injector is not damaged, the fuel supply pipe must be replaced but the injector can be reused.

1. Check the fuel supply pipe for damage and signs of leakage.
   Leakage in the fuel supply pipe can be recognised by erosion tracks (lines) on the nose of the supply pipe. If necessary or if in doubt, replace the fuel supply pipe.

   Note:
   If any indications of leakage are visible, remove the injector and check the injector fuel connection for signs of leakage.

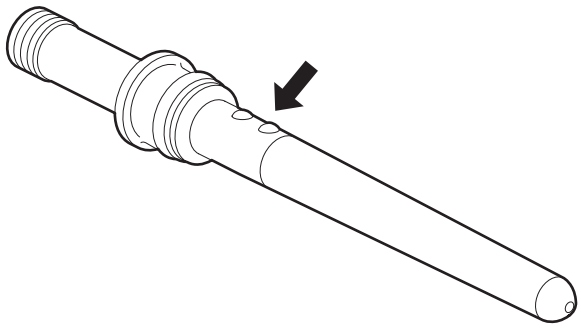

i400776

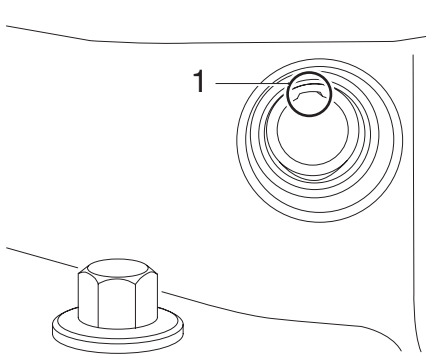
2. Fit a new O-ring on the fuel supply pipe.

3. Apply a thin layer of clean engine oil to the O-ring of the fuel supply pipe, the screw thread of the nut and the contact surface of the nut with the fuel supply pipe.

4. Check the bore of the fuel supply pipe for foreign matter and damage. Also check whether the supply bore in the injector is correctly positioned for the bore, because it is possible to mount the injector turned through 180°, so that the fuel supply port is on the other side.

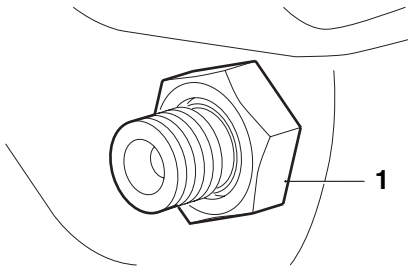
Note:
The fuel supply pipe has one or two positioning balls. The fuel supply pipe can only be installed with the ball(s) on top, as the bore in the cylinder head has a groove (1) at the top. Press the fuel supply pipe as far as possible into the bore, with the ball pointing upwards. Ensure that the O-ring is not damaged in this process.


i400790



i400807

5. Install the nut (1) and tighten it to the specified torque. See "Technical data".
6. If the fuel rail was removed, re-fit it.
7. Fit the injector pipes.
8. Start the engine to bleed the high-pressure section of the fuel system and inspect the fuel system for leaks.



5.3 REMOVAL AND INSTALLATION, INJECTOR

When removing an injector, fuel will escape. Collect the fuel and avoid the risk of fire.

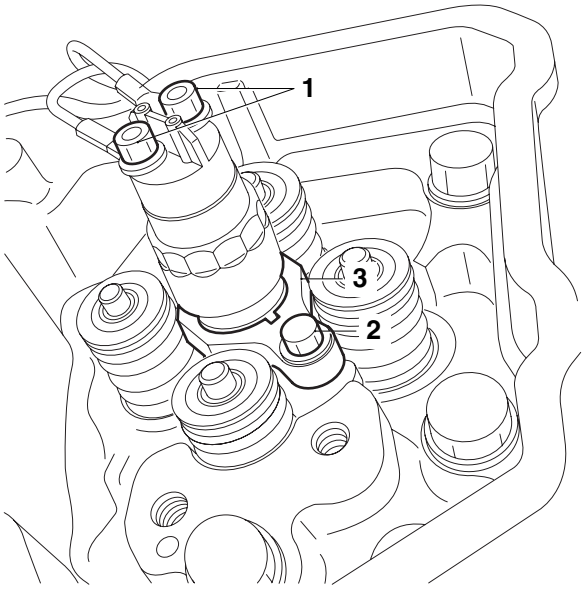
Dirt in the fuel system can lead to significant damage to parts of the system. All open connections must therefore be sealed.

2

Removing the injector

1. Remove the fuel return overflow valve to let the return bore in the cylinder head empty to the fullest possible extent. Collect the escaping fuel.
2. Remove the injector pipe.
3. Remove the fuel supply pipe.

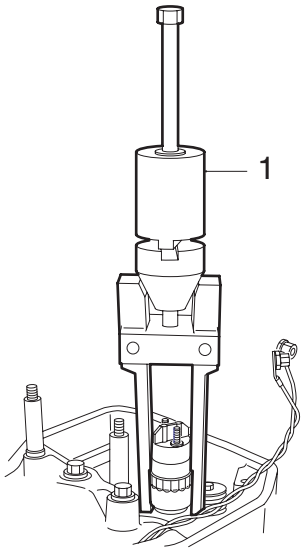
   Note:
   - If an injector is removed without the fuel supply pipe having first been removed, serious damage can ensue.
   - If the injectors are removed, they must be removed together with the fuel supply pipes.
4. Remove the valve cover.
5. Remove the exhaust valve rockers.
6. Remove the injector wiring (1).
7. Remove the two attachment bolts (2) from the injector clamping bracket (3).



i400483

8. Fit the injector puller (1). This is the special tool (DAF no. 0192496). Carefully pull the injector vertically out of the cylinder head.

9. Remove the copper washer from the injector hole and plug the hole immediately.



i400804

Installing the injector
The following guidelines must be adhered to:
- If the injector is defective, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and in addition the sealing surface with the injector is damaged, both the injector and the fuel supply pipe must be replaced.
- If the fuel supply pipe is defective and the sealing surface with the injector is not damaged, the fuel supply pipe must be replaced but the injector can be reused.

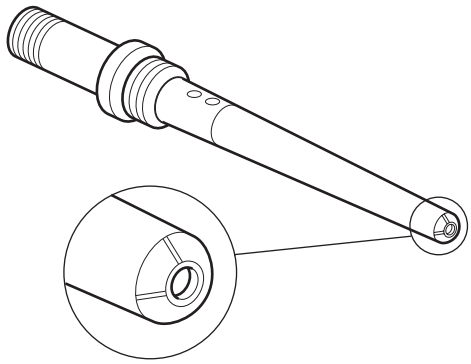
1. Clean the injector if it has already been used. See "Cleaning".

2. Clean the injector hole in the cylinder head. The metal surface of the hole must not be touched.

3. Check the fuel supply pipe for damage and signs of leakage.
   Leakage in the fuel supply pipe can be recognised by erosion tracks (lines) on the nose of the supply pipe. If necessary or if in doubt, replace the fuel supply pipe.

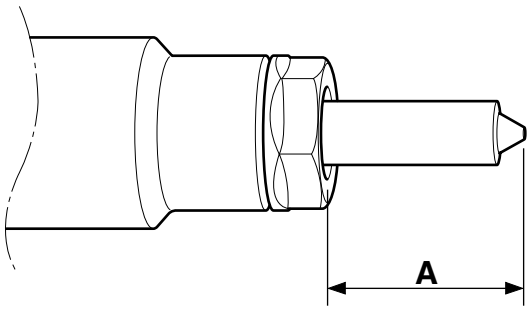
4. Fit a new O-ring on the fuel supply pipe.

5. Check that the injector fuel connection is not leaking.
   Leakage in the injector fuel connection can be recognised by erosion tracks (lines) in the socket of the fuel connection . If necessary or if in doubt, replace the injector.


i400776

6. Fit a new copper washer on the injector. Measure the length of the injector nozzle (A) **without** fitted washer in order to determine which washer must be used. Fit the correct washer; see "Technical data".

   Note:
   A wrong washer will cause an incorrect alignment between the fuel supply pipe and the injector. This will lead to internal fuel leaks that will in turn cause loss of power and/or engine damage.



i400693

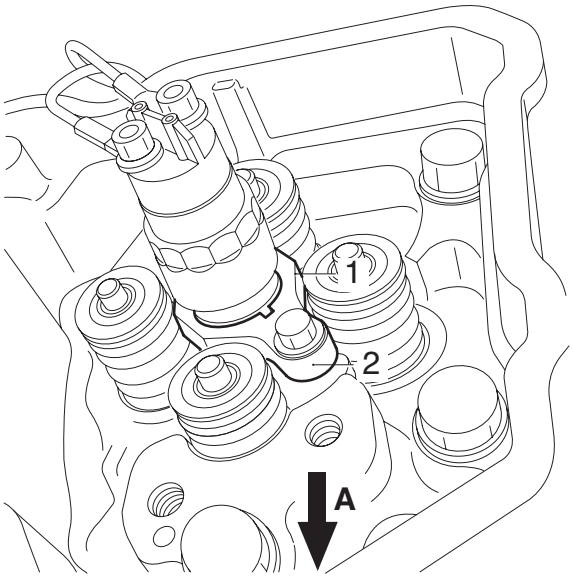
7. Fit a new O-ring on the injector.

   Note:
   This O-ring should prevent returning fuel (1.2 - 2.0 bar) flowing via the top of the cylinder head to the oil sump and thinning the oil.

8. Apply a thin layer of clean engine oil to the O-ring of the injector.

9. Fit the injector with the copper washer. First press the injector into the hole as far as possible until a higher resistance can clearly be felt.

   Note:
   The injector must only be fitted one way. If it is fitted incorrectly, serious damage can ensue. The rounded side (2) of the injector clamping bracket (1) must point to the inlet side of the engine (A).



i400805

10. Fit the attachment bolts (1) in the injector clamping bracket (2) to secure the injector. Tighten the attachment bolts alternately to a torque of 2 Nm.

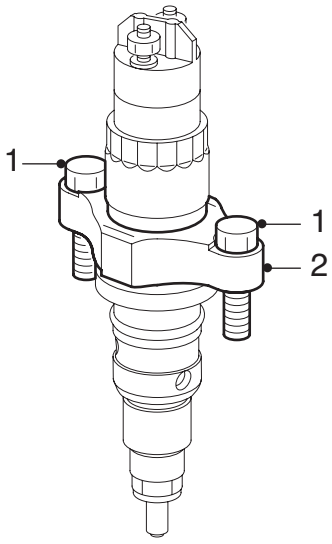
    Note:
    Pay special attention to the tightening of the attachment bolts (1). The tightening must be carried out alternately; ensure that the injector clamping bracket (2) is not fitted at an angle.

11. Apply a thin layer of clean engine oil to the O-ring of the fuel supply pipe, the screw thread of the nut and the contact surface of the nut with the fuel supply pipe.

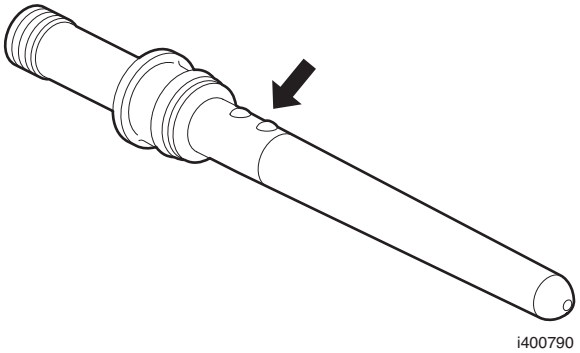
12. Check the bore of the fuel supply pipe for foreign matter and damage. Also check whether the supply bore in the injector is correctly positioned for the bore, because it is possible to mount the injector turned through 180°, so that the fuel supply port is on the other side.

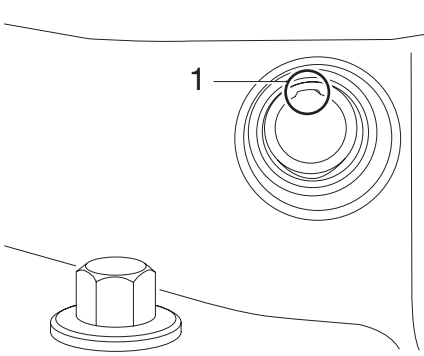
13. Fit the fuel supply pipe. Press the fuel supply pipe as far as possible into the bore, with the ball pointing upwards. Ensure that the O-ring is not damaged in this process.

Note:
The fuel supply pipe has one or two positioning balls. The fuel supply pipe can only be installed with the ball(s) on top, as the bore in the cylinder head has a groove (1) at the top.



i400806


i400790

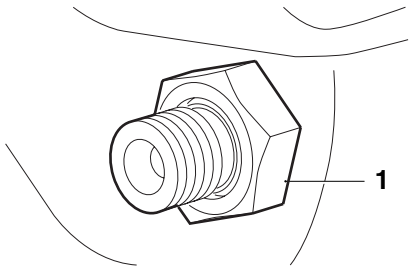


i400807

14. Fit the nut (1). Tighten the nut to a torque of 15 Nm.

15. Tighten the injector attachment bolts to the specified torque; see "Technical data".

16. Tighten the fuel supply pipe nut to the specified torque; see "Technical data".



i400486

17. Connect the injector wiring. Tighten the attachment bolts (1) to the specified torque. See "Technical data".

18. Fit the exhaust valve rockers.

19. Adjust the clearance of the exhaust valves.

20. Fit the valve cover.

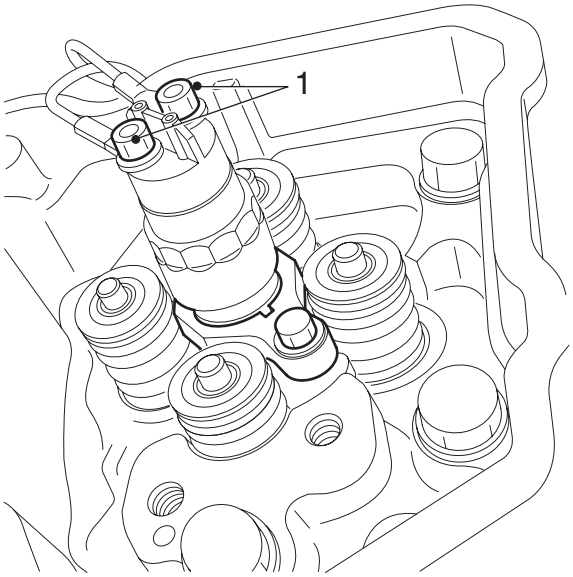
21. If the fuel rail was removed, re-fit it.

22. Fit the injector pipe.

23. Fit the fuel return overflow valve to the cylinder head. For the specified tightening torque, see "Technical data".

24. Connect the return pipe to this valve.

25. Start the engine to bleed the high-pressure section of the fuel system and inspect the fuel system for leaks.



i400808

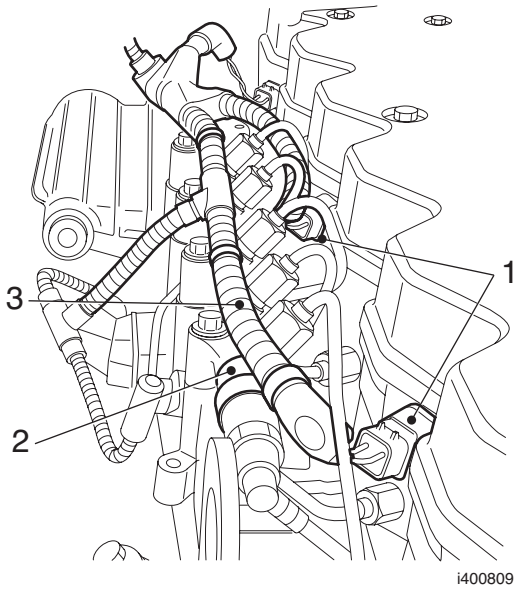
5.4 REMOVAL AND INSTALLATION, FUEL RAIL

When removing the fuel rail, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Removing the fuel rail

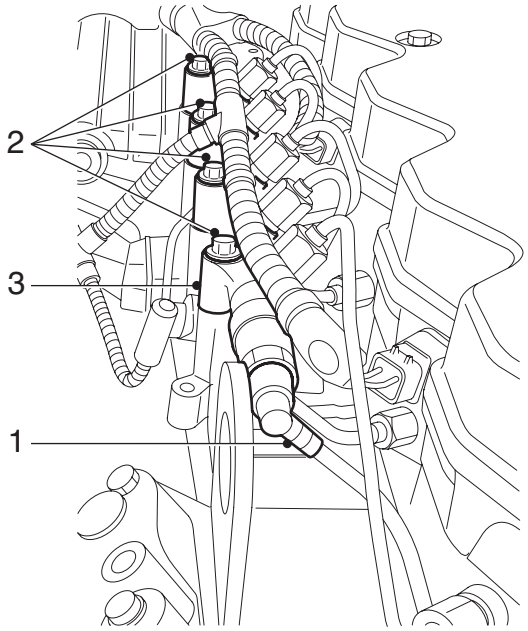
1. Remove the connector from the fuel rail pressure sensor.
2. If necessary, remove the plug of the inlet air temperature/boost pressure sensor by loosening the connector.
3. Remove the connectors of the injectors (1) from the valve sleeve.
4. Disconnect the cable harness (3) on the fuel rail (2) and bend the cable harness away from the fuel rail.



i400809

2

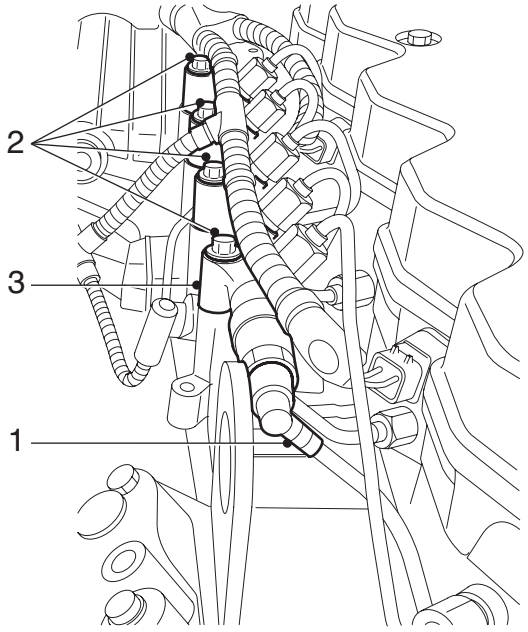
5. Remove the fuel return pipe from the pressure-limiting valve on the fuel rail
6. Loosen the pipe clamps from the high-pressure pipe to the fuel rail.
7. Loosen the high-pressure pipe from the high-pressure pump to the fuel rail on the fuel rail side by unscrewing the union.
8. Disconnect the injector pipes.
9. Remove the fuel rail attachment bolts (2).
10. Remove the fuel rail (3).



i400814

Installing the fuel rail

1. Ensure that the fuel rail is clean.
2. Fit the fuel rail (3) and hand-tighten the attachment bolts (2).
3. Fit the fuel return pipe (1) onto the pressure-limiting valve on the fuel rail.
4. Fit the injector pipes.
5. Fit the pipe clamps from the high-pressure pipe to the fuel rail. Do not tighten them yet.
6. Fit the high-pressure pipe unions from the high-pressure pump to the fuel rail. For the specified tightening torques of the unions, see "Technical data".
7. Tighten the attachment bolts (2) of the fuel rail to the specified torque. See "Technical data".
8. Tighten the bolt connections of the high-pressure pipe clamps.



i400814

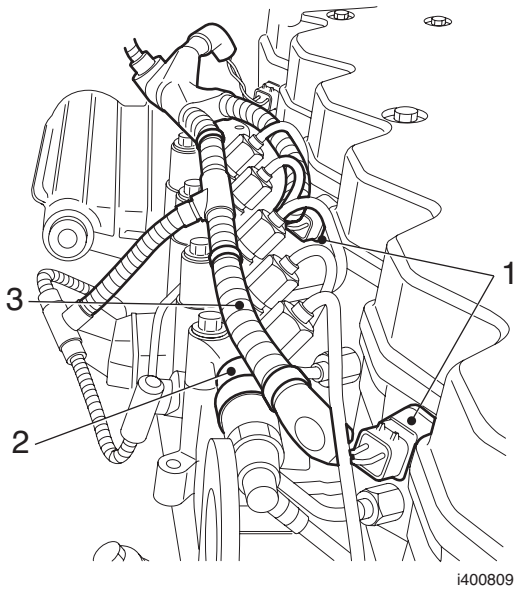
9. Install the cable harness (3) to the fuel rail (2) and secure it using cable ties.

10. Fit the connectors of the injectors (1) in the valve sleeve.

11. If it has been removed, fit the plug of the inlet air temperature/boost pressure sensor to the sensor.

12. Fit the connector of the fuel rail pressure sensor.

13. Start the engine and check the fuel system for leaks.



5.5 REMOVAL AND INSTALLATION, FUEL RAIL PRESSURE-LIMITING VALVE

When removing the pressure-limiting valve, fuel will escape. Collect the fuel and avoid the risk of fire.

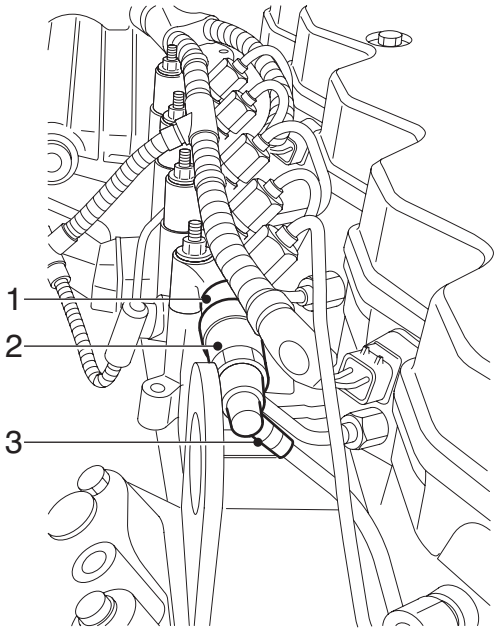
Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Removing fuel rail pressure-limiting valve

1. Clean the pressure-limiting valve (2) and the surrounding area.
2. Remove the fuel return pipe (3) from the pressure-limiting valve (2).
3. Remove the pressure-limiting valve (2) from the fuel rail (1).

Installing fuel rail pressure-limiting valve

1. Check the sealing surface and the screw thread of the pressure-limiting valve and the fuel rail.
2. Install the pressure-limiting valve in the fuel rail and tighten the valve to the specified torque. See "Technical data".
3. Fit the fuel return pipe on the pressure-limiting valve.
4. Start the engine and check the pressure-limiting valve for leaks.



i400779

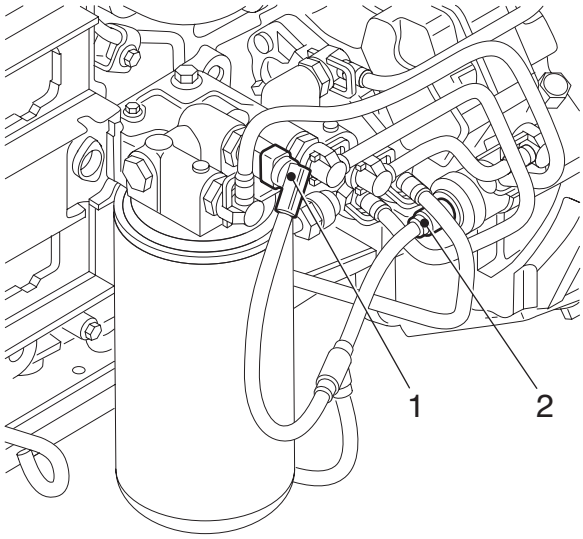
5.6 REMOVAL AND INSTALLATION, HIGH-PRESSURE PUMP

When removing the high-pressure pump, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

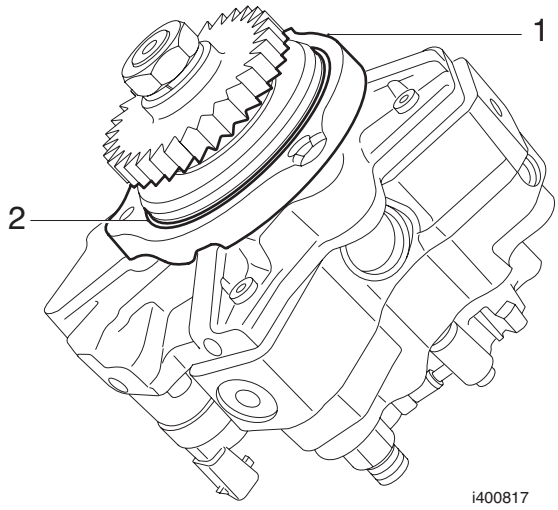
Removing the high-pressure pump

1. Clean the high-pressure pump and that part of the engine around it thoroughly with, for example, a steam cleaner. Cover the places at which leaks have been detected to prevent dirt getting into the fuel system.
2. Disconnect the fuel pipes from the high-pressure pump. Loosen the return pipe only on the high-pressure pump.
3. If fitted, uncouple the connector of the fuel temperature sensor (1) on the fuel fine filter head and the connector of the fuel pump control solenoid valve (2).
4. Remove the fuel fine filter together with the filter head.
5. Loosen both unions from the high-pressure pipe to the fuel rail as well as the pipe clamps. Remove the high-pressure pipe. Plug all openings.
6. Remove the three high-pressure pump attachment nuts and then the high-pressure pump.



i400818

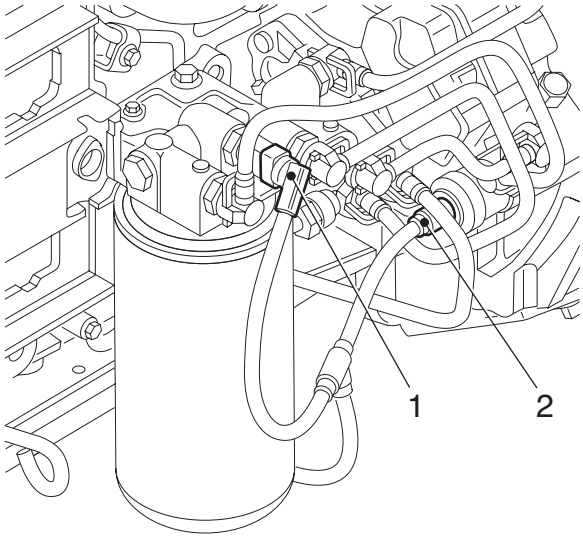
Note:
The high-pressure pump is fitted on the gear side with an adapter ring (1) and an O-ring (2) in the timing gear case. If the removal of the high-pressure pump is particularly difficult, it may be necessary to press the adapter ring (1) carefully out of the timing gear case using a small pry bar.



2

Installing the high-pressure pump

1. Clean the high-pressure pump. Make sure that no dirt or cleaner can get into the high-pressure pump ducts.
2. Check the high-pressure pump and the drive gear (externally) for wear and damage.
3. Fit a new O-ring (2) on the adapter ring (1) and apply a thin layer of engine oil to the O-ring.
4. Fit the high-pressure pump and press it into the timing gear case by means of the attachment nuts.
5. Tighten the attachment nuts to the specified torque. See "Technical data".
6. Fit the filter head and the fuel fine filter.
7. Fit the high-pressure pump to the fuel rail and tighten the unions. See "Technical data" for the specified tightening torques.
8. Tighten the pipe clamps.
9. If fitted, connect the connector of the fuel temperature sensor (1) on the fuel fine filter head and the connector of the fuel pump control solenoid valve (2).
10. Fit the fuel pipes to the high-pressure pump.
11. Bleed the fuel system. See "Inspection and adjustment".
12. Start the engine and check the fuel system for leaks.



5.7 REMOVAL AND INSTALLATION, FUEL FINE FILTER

When removing the fuel fine filter, a quantity of fuel will escape. Collect the fuel and avoid the risk of fire.

Removing the fuel fine filter

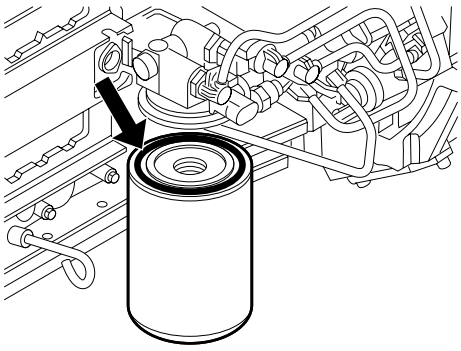
1. Place a container beneath the fuel fine filter and remove the filter.

   Note:
   The fuel fine filter is a disposable filter and must therefore not be cleaned and re-used.

Installing the fuel fine filter

Note:
Do not fill the fine filter with fuel until it has been fitted. The fine filter is filled with fuel by the primer pump after it has been fitted. This considerably reduces the risk of dirt getting into the fuel system.

1. Check by hand whether the coupling piece for the filter attachment is securely attached.
2. Lightly lubricate the filter sealing ring with clean engine oil.
3. Fit the filter element onto the housing. Tighten the filter element until the sealing ring abuts. Tighten the filter element a further ½ to ¾ turn by hand.
4. Bleed the fuel system. See "Inspection and adjustment".
5. Start the engine and check the fuel system for leaks. If necessary, retighten the filter by hand.



G0 00 201

5.8 REMOVAL AND INSTALLATION, FUEL PREFILTER/WATER SEPARATOR FILTER ELEMENT

When removing the fuel prefilter/ water separator, a quantity of fuel will escape. Collect the fuel and avoid the risk of fire.

2

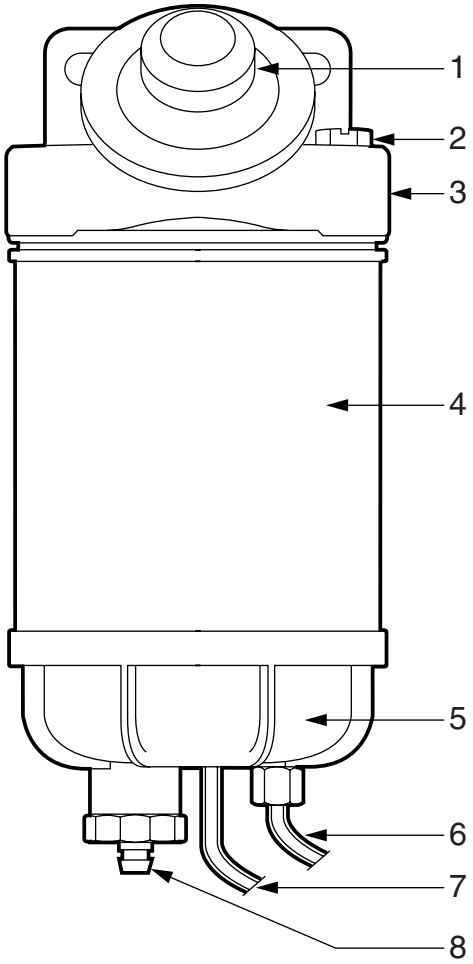
Racor fuel prefilter/water separator

Removing the fuel prefilter/water separator filter element

1. Place a tray beneath the filter to capture any escaping fuel.
2. Drain the fuel from the filter element by unscrewing the vent plug (2) and opening the drain plug (8).
3. If fitted, disconnect the water sensor (6) and the heating element (7) connectors.
4. Remove the filter element (4) together with the bottom cover (5) and clean the O-ring seal.

Installing the fuel prefilter/water separator filter element

1. Apply a thin layer of engine oil to the O-ring and the new sealing ring.
2. Fit the bottom cover (5) onto the new filter element (4).
3. Fit the bottom cover (5) together with the new filter element (4) onto the filter housing (3).
4. Hand-tighten the new filter.
5. If fitted, attach the water sensor and heating element connectors.
6. Vent the fuel system. See "Inspection and adjustment".
7. Start the engine and check for leaks. If necessary, retighten the filter element (4) of the fuel prefilter/water separator by hand.

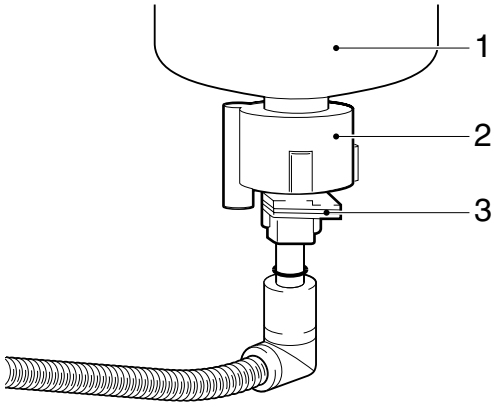


i400356

Fleetguard fuel prefilter/water separator

Removing the fuel prefilter/water separator filter element

1. Place a tray beneath the filter to capture any escaping fuel.
2. Remove the plug (3) from the water sensor (2).
3. Remove the filter element (1) of the fuel prefilter/water separator by turning it anti-clockwise.
4. Remove the water sensor (2) from the filter element (1).



G0 00 220

Installing the fuel prefilter/water separator filter element

1. Check by hand whether the coupling for the filter attachment is securely attached.
2. Lightly lubricate the sealing ring with engine oil.
3. Fit the fuel prefilter/water separator filter element (1) until the sealing ring abuts. Tighten the filter element a further ½ to ¾ turn by hand.
4. Turn the water sensor (2) onto the filter element until it abuts. Turn the water sensor a further approx. ⅛ - ¼ turn.

   Note:
   Over-tightening the water sensor (2) may damage the sensor and/or cause leakage.
5. Fit the plug (3) of the water sensor (2).
6. Vent the fuel system. See "Inspection and adjustment".
7. Start the engine and check for leaks. If necessary, retighten the filter element (1) of the fuel prefilter/water separator by hand.

5.9 REMOVAL AND INSTALLATION, FUEL LEVEL ELEMENT

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

2

Removal, fuel level element

1. Disconnect the earth lead from the battery terminal.

   Note:
   To prevent dirt from entering, first clean the fuel tank.

2. Remove the connector from the fuel level element.

3. Remove the fuel pipes from the fuel level element.

4. Turn the fuel level element a quarter turn anti-clockwise.

5. Carefully remove the fuel level element from the fuel tank.

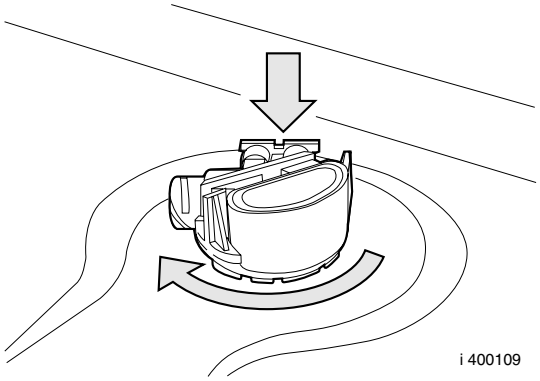
6. Replace the O-ring.

Installation, fuel level element

1. Check that the fuel pipes are fitted correctly in the tank filter.

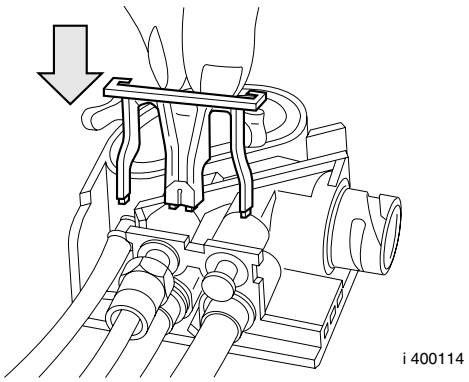
2. Fit the fuel level element carefully in the fuel tank.

3. Insert the fuel level element into the hole of the tank and turn it clockwise a quarter turn.



4. Insert the fuel pipes into the fuel level element.

5. Fit the connector of the fuel level element.



5.10 REMOVAL AND INSTALLATION, FUEL TANK FILTER

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

2

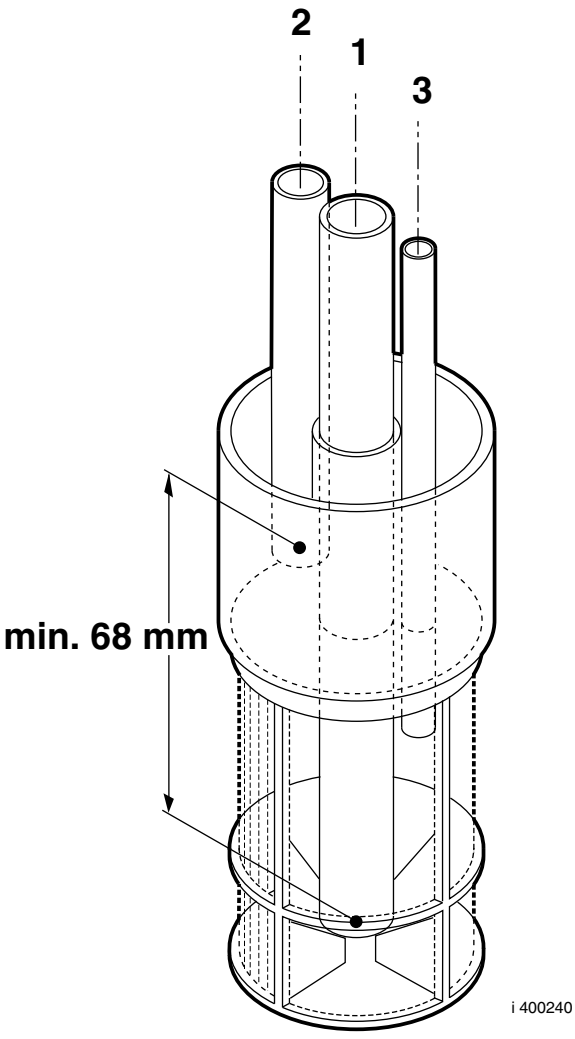
Removing fuel tank filter

1. Remove the fuel level element.
2. Remove the fuel tank filter.

Fitting fuel tank filter

1. Check that the difference in length between the supply pipe (1) and return pipe (2) is at least 68 mm.
2. Slide the fuel tank filter as far as possible onto the supply pipe (1).

   Note:
   Make sure that when fitting the fuel tank filter the return pipe (2) is inserted into the fuel tank filter by-pass and that the cab heater supply pipe (3), if present, is inserted into the filter part.
3. Fit the fuel level element.



5.11 REMOVAL AND INSTALLATION, ELECTRONIC UNIT COOLING PLATE

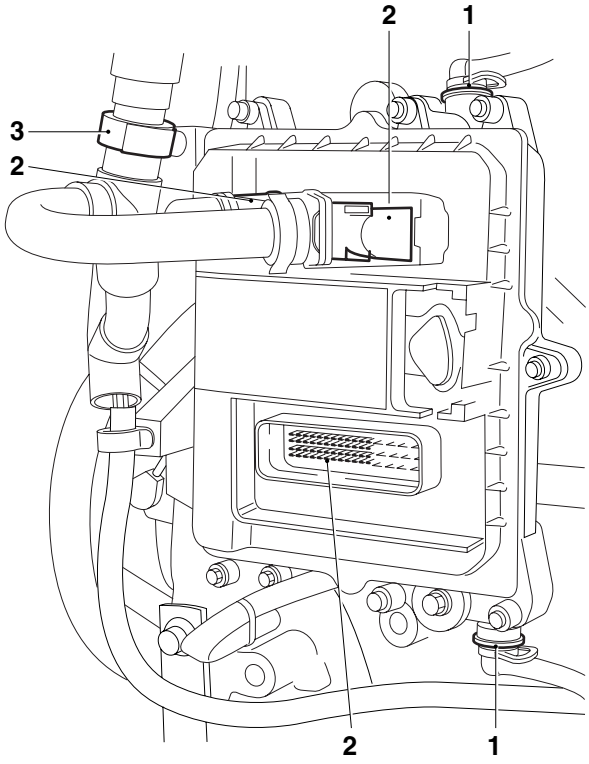
When removing the cooling plate, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Note:
The electronic unit, together with the cooling plate, must first be removed from the engine block, after which the cooling plate must be demounted.

Removing electronic unit cooling plate

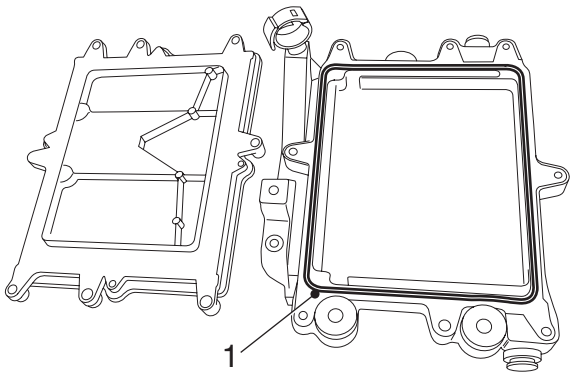
1. Disconnect the earth lead from the battery terminal.
2. To prevent dirt from entering, first clean the area around the fuel connections.
3. Remove the fuel pipes (1) on the cooling plate of the electronic unit.
4. Uncouple the electrical connectors (2) from the electronic unit and loosen the attachment clip (3) from the cable harness.
5. Remove the attachment bolts by which the electronic unit is fitted to the engine block.
6. Remove the electronic unit and cooling plate.
7. Remove the attachment bolts by which the electronic unit is fitted to the cooling plate and remove the cooling plate.



i400500

Installing electronic unit cooling plate

1. Clean the cooling side of the electronic unit and the cooling plate.
2. Inspect the sealing surfaces of the cooling plate and the electronic unit for damage and smoothness.
3. Fit a new sealing rubber (1) in the cooling plate.
4. Fit the cooling plate to the electronic unit and fit the bolts attaching the two parts. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Fit the electronic unit and cooling plate to the engine block and fit the attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
6. Connect the electrical connectors to the electronic unit and attach the cable harness with the clips.
7. Connect the quick-release couplings of the fuel pipes to the electronic unit cooling plate.
8. Bleed the fuel system. See "Inspection and adjustment".
9. Fit the earth lead to the battery terminal.
10. Start the engine and check the fuel system for leaks.



i400819

5.12 REMOVAL AND INSTALLATION, FUEL RETURN OVERFLOW VALVE

When removing the fuel return overflow valve valve, fuel will escape. Collect the fuel and avoid the risk of fire.

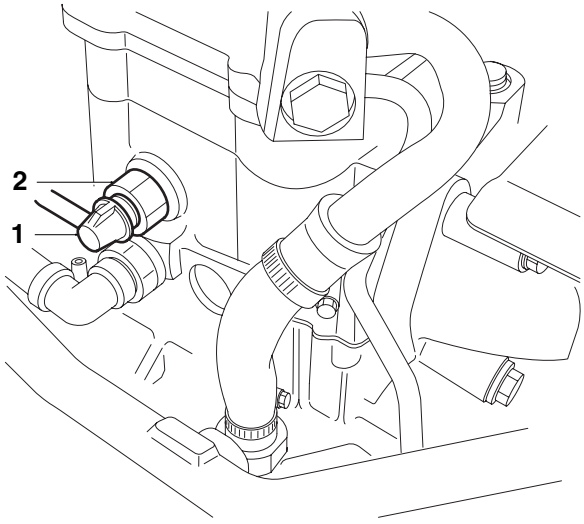
Dirt in the fuel system can lead to significant damage to parts of the system. Prevent this by cleaning the parts before disassembly and then sealing all open connections.

Removing the fuel return overflow valve

1. To prevent dirt from entering, first clean the area around the fuel return connection.
2. Remove the fuel return pipe (1) on the fuel return overflow valve (2) and plug the pipe.
3. Remove the fuel return overflow valve and collect the escaping fuel.

Installing the fuel return overflow valve

1. Install the fuel return overflow valve. Haal het brandstofretour-overstroomventiel aan met het voorgeschreven aanhaalmoment, zie hoofdgroep "Technische gegevens".
2. Connect the quick-release couplings of the fuel return pipe to the fuel return overflow valve.
3. Start the engine and check the fuel system for leaks.



i400502

5.13 REMOVAL AND INSTALLATION, LOW-PRESSURE FUEL PIPES

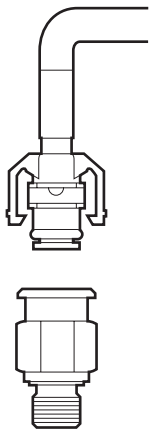
When removing the low-pressure fuel pipes, fuel will escape. Collect the fuel and avoid the risk of fire.

Dirt in the fuel system can lead to significant damage to parts of the system. All open connections must therefore be sealed.

2

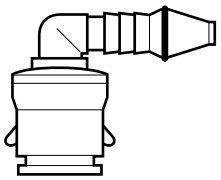
The low-pressure fuel pipes may have two different types of quick-release coupling.

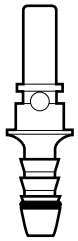
VOSS quick-release coupling



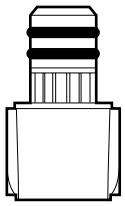
i400881

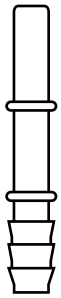
John Guest quick-release coupling





i400882





i400884

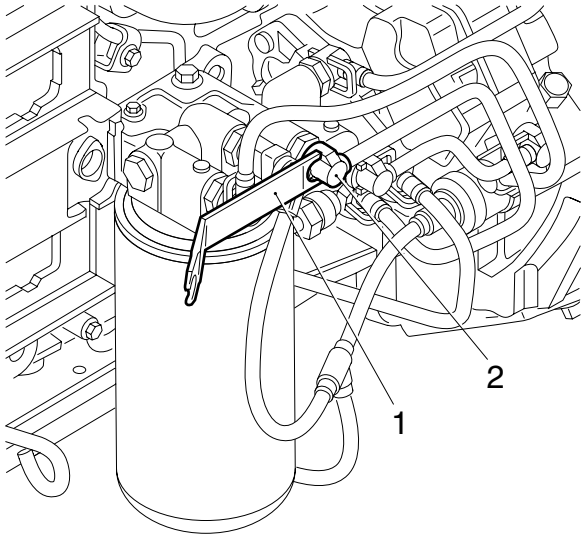
Low-pressure fuel pipes fitted with VOSS quick-release couplings

Removing low-pressure fuel pipes

1. Disconnect the fuel pipe (2) by inserting the special tool (1)(DAF no. 1329470) into the quick-release coupling and removing the pipe from the coupling.
2. Remove the special tool from the quick-release coupling.
3. Plug the openings.

Fitting low-pressure fuel pipes

1. Clean the quick-release coupling parts and apply a thin layer of clean engine oil to the O-ring.
2. Fit the pipe on the quick-release coupling of the component and push the pipe onto it until a clear resistance can be felt and the quick-release coupling audibly clicks.
3. Bleed the fuel system. See "Inspection and adjustment".
4. Start the engine and check the fuel system for leaks.



i400473

Low-pressure fuel pipes fitted with John Guest quick-release couplings

Removing low-pressure fuel pipes

1. Disconnect the fuel pipe by pressing in both lips of the quick-release coupling and removing the pipe from the quick-release coupling.

2. Plug the openings.

Fitting low-pressure fuel pipes

1. Clean the quick-release coupling parts.

2. Fit the pipe on the quick-release coupling of the component and push the pipe onto it until a clear resistance can be felt and the quick-release coupling audibly clicks.

3. Bleed the fuel system. See "Inspection and adjustment".

4. Start the engine and check the fuel system for leaks.

2

© 200416

6. CLEANING

6.1 CLEANING INJECTOR

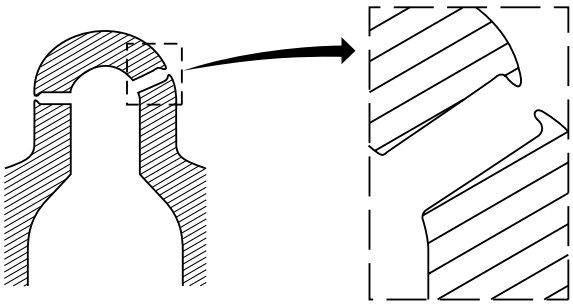
The injector must never be cleaned with a steel brush or pressure cleaning equipment. Never put the brush in the injector bores when cleaning the exterior of the injector nozzle. If this happens, the nozzle must be replaced.
Before cleaning the nozzle, cover the injector bores. Only clean the injector with a brass hand brush.

Note:
The use of steel brushes can cause deformation of the injector bores, with the result that the wrong amount of fuel is injected.
This deformation cannot be ascertained by measurements or checks.

Note:
The disassembly and assembly of injectors is not permitted. Only external cleaning is permitted.

1. Remove the injector. See "Removal and installation".

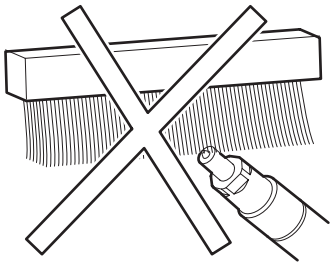
2. Clean the injector hole in the cylinder head. The metal surface of the hole must not be damaged.

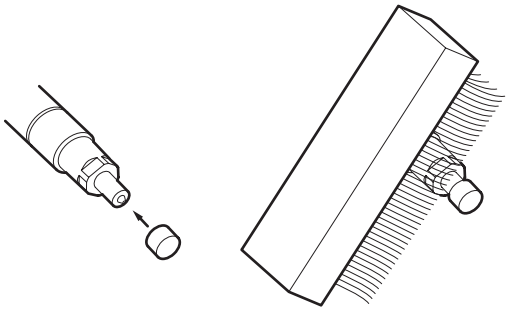


M2 00 040

3. Wipe the exterior of the injector with a clean, lint-free cloth. In the case of heavy soiling the injector may be cleaned carefully with a brass hand brush (not the apertures in the injector nozzle!).

4. Fit the injector. See "Removal and installation".





i 400413

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200416
1.1	Safety instructions	1-1	200416
2.	**GENERAL**	2-1	200416
2.1	Location of components	2-1	200416
2.2	System description, turbocharger with wastegate	2-3	200416
3.	**INSPECTION AND ADJUSTMENT**	3-1	200416
3.1	Inspecting turbocharger wastegate	3-1	200416
3.2	Inspecting turbocharger axial bearing play	3-2	200416
3.3	Inspecting turbocharger radial bearing play	3-3	200416
3.4	Checking exhaust gas back pressure	3-4	200416
3.5	Inspection and pressure-testing, air inlet system	3-5	200416
3.6	Checking inlet underpressure	3-7	200416
4.	**REMOVAL AND INSTALLATION**	4-1	200416
4.1	Removal and installation, turbocharger	4-1	200416
4.2	Removal and installation of air cooler	4-4	200416
4.3	Removal and installation, air filter element	4-6	200416
4.4	Removal and installation, glow plug	4-8	200416
5.	**CLEANING**	5-1	200416
5.1	Cleaning the exterior of radiator/air cooler	5-1	200416

3

© 200416

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

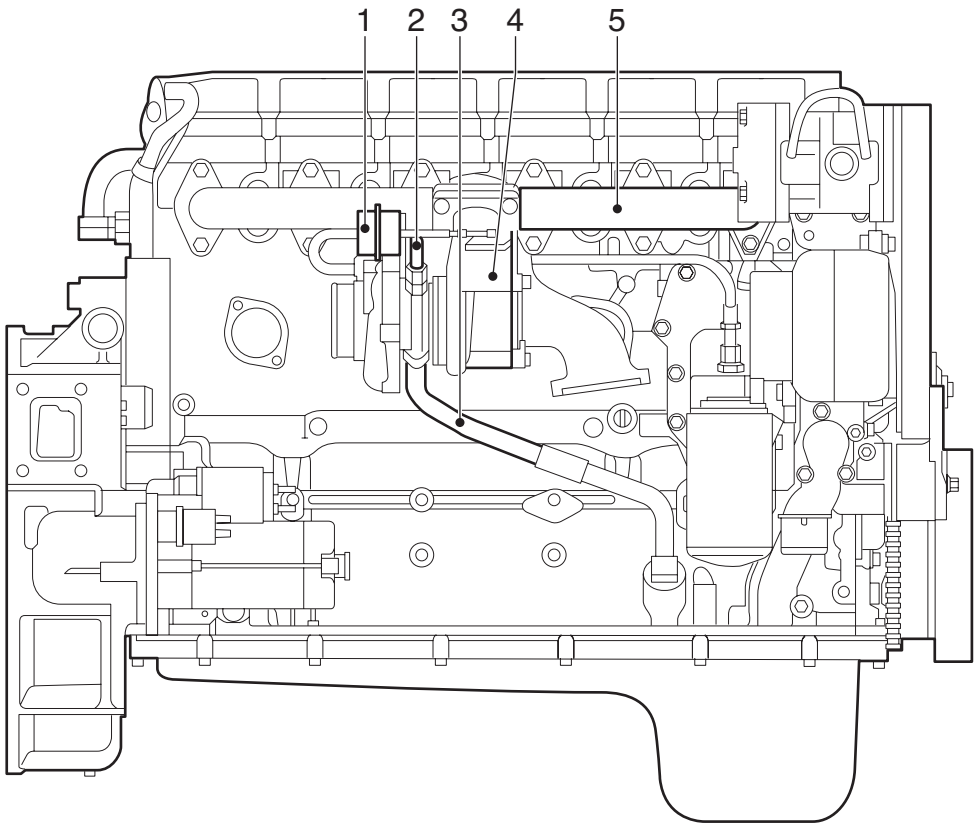
Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

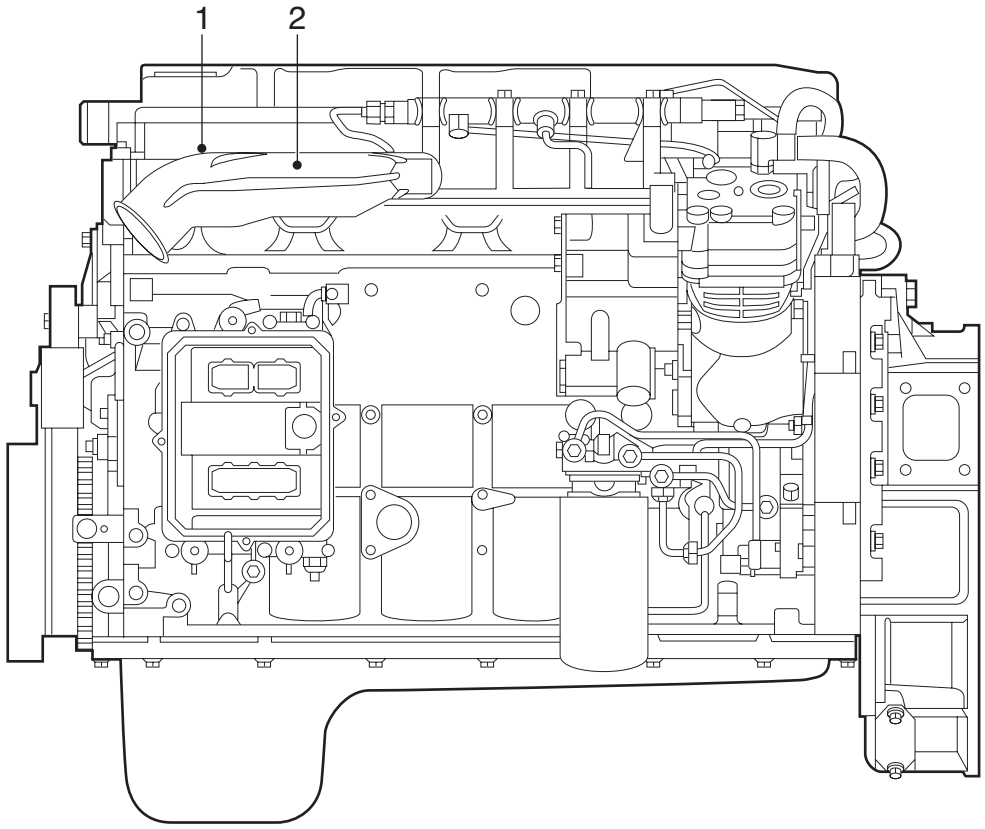
© 200416

2. GENERAL

2.1 LOCATION OF COMPONENTS



1. Wastegate diaphragm box
2. Oil supply pipe
3. Oil discharge pipe
4. Turbocharger
5. Exhaust manifold



i400841

1. Glow element connections
2. Intake manifold

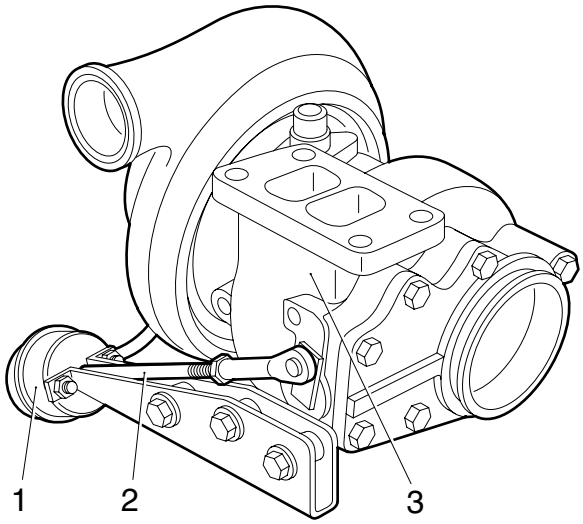
© 200416

2.2 SYSTEM DESCRIPTION, TURBOCHARGER WITH WASTEGATE

To make the engine more responsive at lower engine speeds, a turbocharger is used that produces a better charge ratio at these speeds. Without provision having been made for this, the boost pressure yielded by this turbocharger would be too high at maximum engine speeds. Use of a wastegate prevents this.

The boost pressure is measured by a diaphragm box (1) on the delivery side of the turbocharger. The diaphragm is pushed back against the spring pressure by the boost pressure. The linked control rod (2) is also pushed back. The control rod operates a valve in the turbine housing (3). The valve in the turbine housing is opened when the maximum pre-set pressure has been reached.

When the valve is opened, some of the exhaust gases will be discharged directly to the exhaust pipe rather than being used to propel the turbine rotor of the turbocharger.



i400509

3

© 200416

3. INSPECTION AND ADJUSTMENT

3.1 INSPECTING TURBOCHARGER WASTEGATE

Note:
Depending on the fitting position of the turbocharger, it may be necessary to remove the turbocharger from the engine before this adjustment; see "Removal and installation".

Note:
The turbocharger is calibrated in the factory and must not be re-adjusted. The length of the control rod on the wastegate valve lever may only be changed when assembling a new turbocharger. After that, only an inspection of the actuating pressure of the wastegate may be carried out. If the result is negative, the turbocharger must be replaced.

1. Remove the flexible pipe (2) from the diaphragm box (1) of the wastegate.

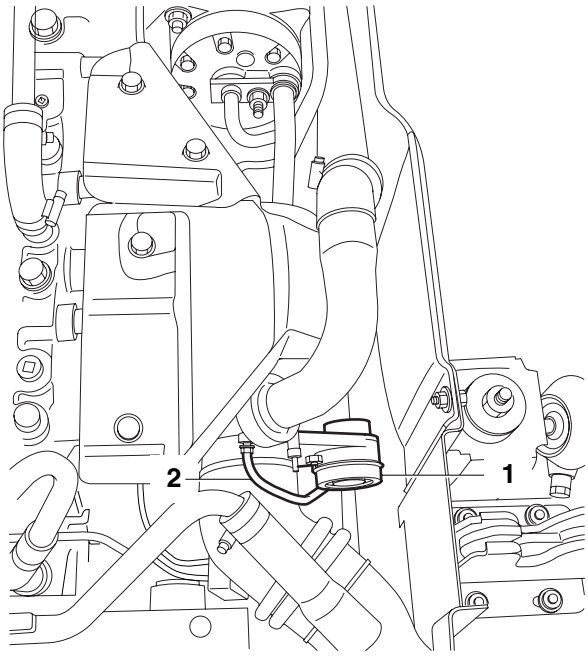
2. Connect an air-pressure reducer valve to the diaphragm box of the wastegate. Set the reducer valve to max. 0.2 bar gauge pressure. Connect the reducer valve to a compressed air installation.

3. Set the reducer valve to exactly the same test pressure as listed in "Technical data".

4. Check the diaphragm in the diaphragm box for leaks by listening carefully for a hissing sound from the diaphragm box.

5. Check whether the control rod of the wastegate has moved. If it has not moved, the control rod must be loosened from the lever. Check again whether the control rod has moved. If is has not moved, the diaphragm box must be replaced. If it has moved, the wastegate valve must be made to move freely or, if that does not help sufficiently, the entire compressor unit must be replaced.

6. Remove the flexible pipe with the reducer valve and re-connect the flexible pipe of the compressor pump to the wastegate diaphragm box.

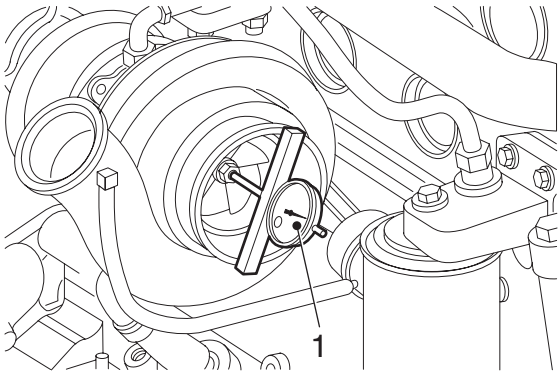


i400510

3.2 INSPECTING TURBOCHARGER AXIAL BEARING PLAY

Note:
The turbocharger axial bearing play should only be checked when the engine is cold.

1. Remove the exhaust pipe from the turbocharger.
2. Remove the charge pipes from the turbocharger.
3. Fit a dial gauge (1) to the charge supply flange of the turbocharger.
4. Push the compressor shaft away from the dial gauge and set the gauge to zero.
5. Push the compressor shaft to the dial gauge and read off the axial play. Compare the reading with the specified value; see "Technical data". Replace the turbocharger if necessary.
6. Fit the charge pipes to the turbocharger.
7. Fit the exhaust pipe to the turbocharger.



i400821

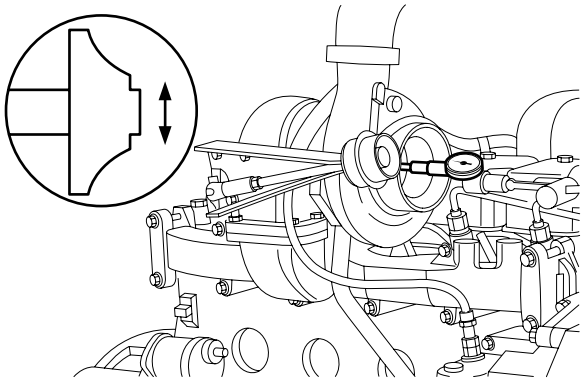
3.3 INSPECTING TURBOCHARGER RADIAL BEARING PLAY

Note:
The turbocharger radial bearing play should only be checked when the engine is cold.

1. Remove the turbocharger from the exhaust manifold. See "Removal and installation".

2. Fit a pressure gauge to the turbocharger housing and measure the radial play. Compare the reading with the specified value; see "Technical data". Replace the turbocharger if necessary.

3. Fit the turbocharger. See "Removal and installation".



i400650

3.4 CHECKING EXHAUST GAS BACK PRESSURE

Checking exhaust gas back pressure

1. Remove the plug from the exhaust elbow attachment or bore a hole and install a suitable coupling with a pipe. The first part of the pipe must be made of metal, to withstand the high temperatures.

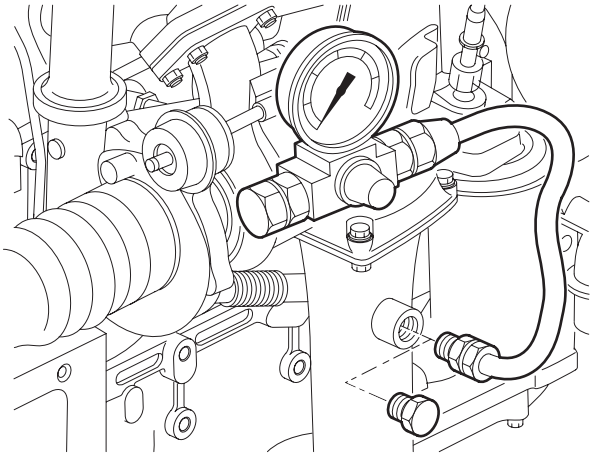
   Note:
   Use an attenuated gauge to prevent excessive shaking of the gauge needle.

2. Connect a pressure gauge to the pipe, with a range of at least 0.1 - 0.2 bar (10 - 20 kPa).

   Note:
   The engine brake must not be used during measurements. This is to protect the pressure gauge.

3. Measure the exhaust gas back pressure at full-load engine speed and compare the measurements to the specified value. See "Technical data". Check the exhaust system if the exhaust gas back pressure is too high.

4. Remove the pressure gauge and the coupling and fit the plug.



i400513

3.5 INSPECTION AND PRESSURE-TESTING, AIR INLET SYSTEM

When pressure-testing the air inlet system, the plugs may spring off if they are not properly secured. It is therefore important to check the attachment of the plugs before pressure-testing and keep people away from the area.

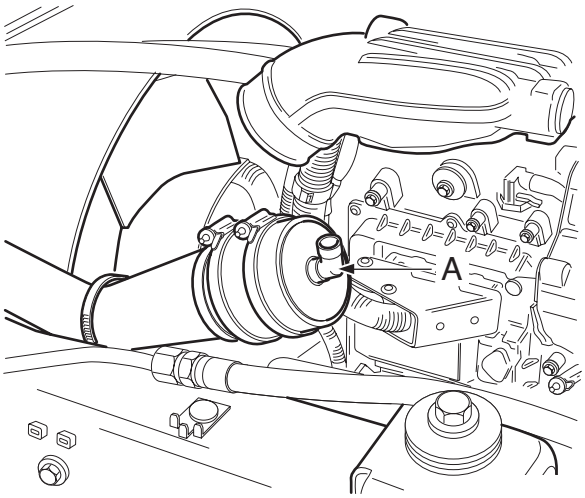
1. Check the condition and mounting of the air inlet channels/pipes of the air inlet system.

   Note:
   In case of doubt as to the proper sealing of the air inlet system, which is indicated by the following:
   - loss of power
   - high fuel consumption
   - unusual noises
   - lit engine fault symbol on the instrument panel, ???carry out a pressure test to check the air inlet system for leakage.

2. Remove the right-hand and rear engine encapsulations.

3. Loosen the inlet hose between the air cooler and the inlet manifold at the inlet manifold side.

4. Fit the special tool (DAF no. 1453171) in the hose.



i400856

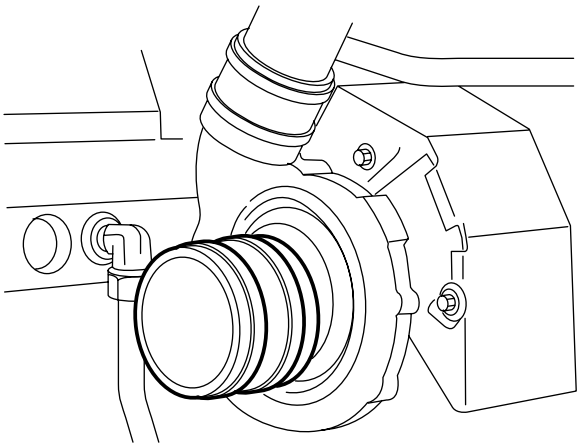
5. Loosen the plastic pipe between the air filter housing and the rubber suction hose on the turbocharger.

6. Install special tool (DAF no. 0694831) in the rubber intake port on the turbocharger.

7. Connect an air pipe with reducer valve to the sealing cap (A) and charge the system to approx. 1 bar.

8. Use a soapy solution to check the whole inlet system for air leaks. Also check whether the pressure gauge of the reducer valve drops.

9. Fit the loosened hoses of the inlet system and the engine encapsulation.

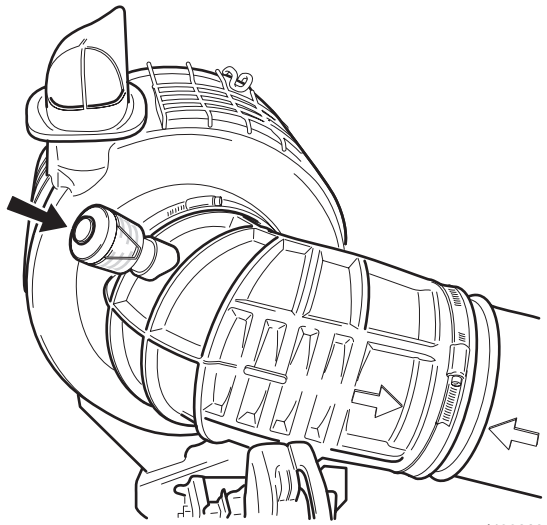


i 400376

© 200416

3.6 CHECKING INLET UNDERPRESSURE

1. Remove the air filter indicator from the inlet pipe between the air filter housing and the turbocharger.
2. Connect a pressure gauge with a maximum rating of -100 mbar (-10 kPa) to the connection of the air filter indicator.
3. Measure the inlet underpressure at full-load engine speed and compare the measurement to the specified value. See "Technical data".
4. Remove the pressure gauge and fit the air filter indicator.


i400869

© 200416

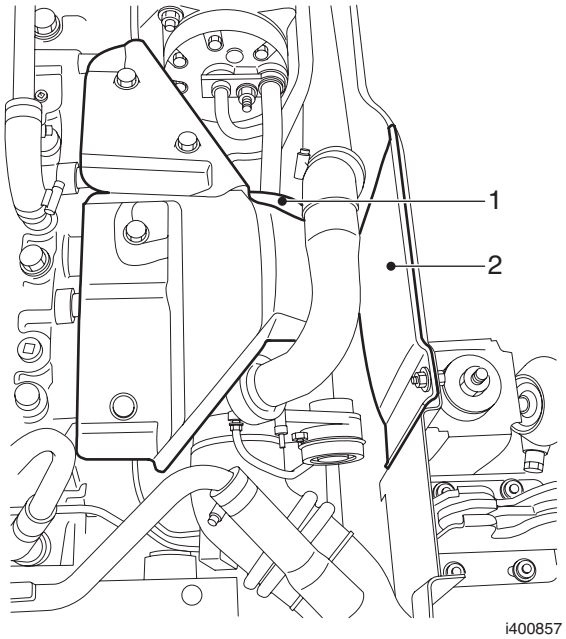
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, TURBOCHARGER

If the turbocharger to be replaced has been damaged to such an extent that parts of it are missing or lubricating oil has entered the inlet system, the inlet and exhaust systems must be checked and cleaned thoroughly in order to prevent serious damage to the engine.

Removing the turbocharger

1. Remove the right-hand engine encapsulation (2).
2. Remove the heat shield (1) from the oil filter.
3. Remove each charge pipe and the turbocharger exhaust pipe.
4. Remove the oil discharge pipe from the turbocharger.
5. Detach the entire oil supply pipe from the oil filter housing to the turbocharger.
6. Remove the attachment bolts from the turbocharger.
7. Remove the turbocharger.
8. Immediately plug the openings.



i400857

Installing the turbocharger

1. Clean the turbocharger and the oil supply and discharge pipes.

2. Before installing the turbocharger, check the following:
   - the turbocharger housing and connector flange for cracks. See "Technical data" for rejection standards;
   - the turbocharger shaft must be able to rotate freely;
   - the turbocharger shaft must not run out of true;
   - the turbocharger pump and turbine wheels must not be damaged;
   - there must not be an excessive amount of oil in the compressor side of the turbocharger. A small amount of oil on the inside walls of the compressor side is allowed.

3. Check the adjustment of the turbocharger wastegate. See "Inspection and adjustment".

4. Check the axial bearing play of the turbocharger; see "Inspection and adjustment".

5. Check the radial bearing play of the turbocharger; see "Inspection and adjustment".

6. Clean the sealing surfaces.

   Note:
   Always use new gaskets when installing the turbocharger.

7. Apply a layer of Copaslip to the exhaust manifold studs.

8. Fit the turbocharger to the exhaust manifold.

9. Fit the attachment nuts and tighten them to the specified torque. See "Technical data".

10. Check that the oil supply and discharge pipes are clean and not blocked, kinked or cracked. Replace the pipes if necessary.

    Note:
    If the turbocharger oil supply and/or discharge does not function properly, this may result in serious damage to the turbocharger and/or engine.

11. Fit new O-rings to the oil discharge pipe and apply a thin layer of engine oil to them. Fit the oil discharge pipe. For the specified tightening torque, see "Technical data".

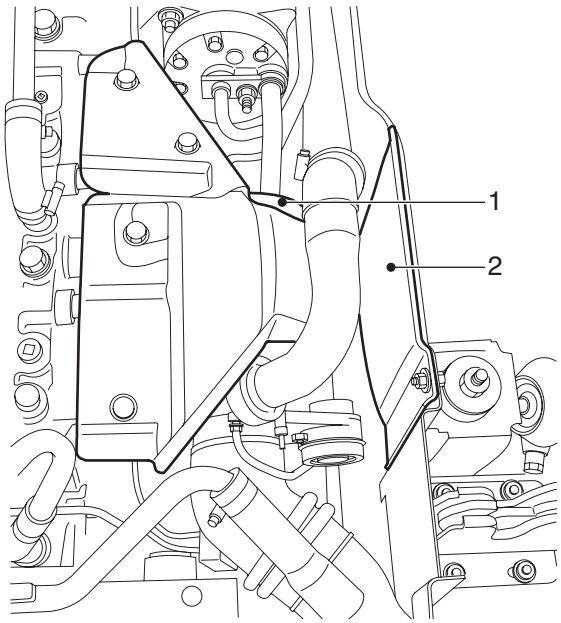
12. Pour clean engine oil into the oil supply of the turbocharger and fit the oil supply pipe, after fitting a new copper ring, on the oil filter housing and the turbocharger. Tighten the pipe to the specified tightening torque; see "Technical data".

13. Fit the exhaust pipe to the turbocharger.

14. Fit the charge pipes to the exhaust pipe.

15. Fit the heat shield (1) to the oil filter.

16. Install the engine encapsulation (2).



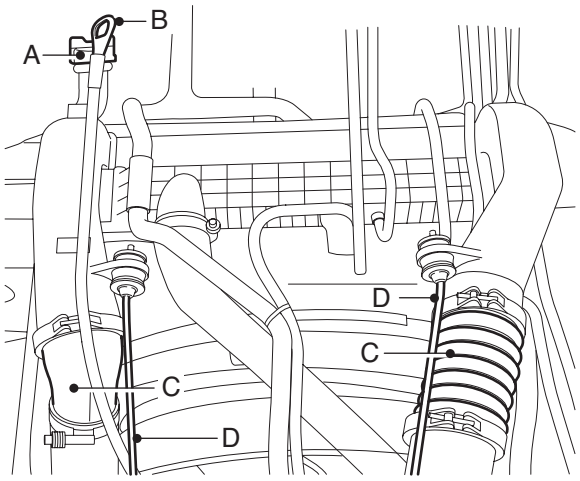
4.2 REMOVAL AND INSTALLATION OF AIR COOLER

Note:
The removal and installation procedure of the air cooler allows for the presence of an air-conditioning unit.

If such a unit is not present, the sections concerned can be skipped.

Removing the air cooler

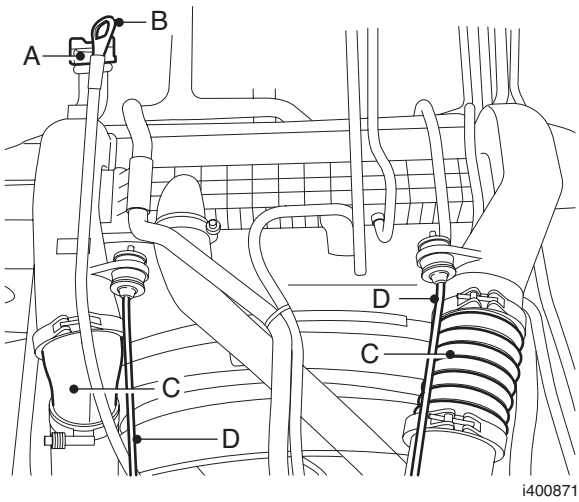
1. Partially drain the coolant.
2. Disconnect the oil filler pipe (A) from the air cooler.
3. Disconnect the dipstick holder (B) from the air cooler.
4. Remove the air inlet hoses (C) between the engine and the air cooler.
5. Disconnect all rubber hoses that run along the air cooler.
6. Disconnect the torque rods (D) at the side of the air cooler.
7. Disconnect the air-conditioning condenser (if applicable) including accessories from the radiator.
8. Disconnect the air-conditioning compressor, if applicable, from the engine and carefully put the complete air-conditioning system to one side.
9. Disconnect the air cooler from the radiator and remove the air cooler.



i400871

Installing the air cooler

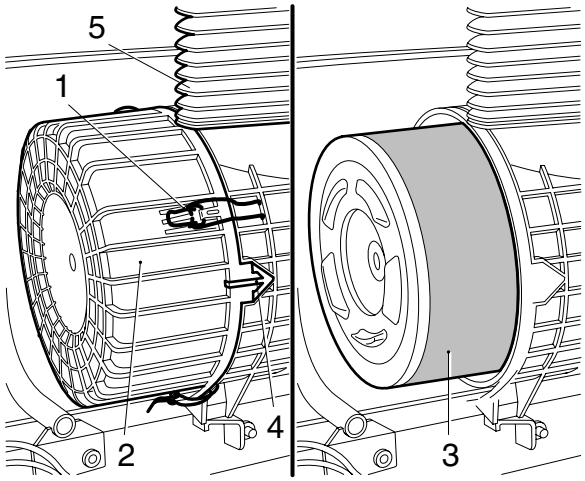
1. Fit the air cooler and secure it against the radiator.
2. Fit the air-conditioning condenser (if applicable) including accessories onto the radiator.
3. Fit the air-conditioning compressor, if applicable, to the engine.
4. Install the torque rods (D).
5. Fit all rubber hoses that run along the air cooler.
6. Fit the air inlet hoses (C) between the engine and the air cooler.
7. Fit the dipstick holder (B) to the air cooler.
8. Fit the oil filler pipe (A) to the air cooler.
9. Top up the cooling system.



4.3 REMOVAL AND INSTALLATION, AIR FILTER ELEMENT

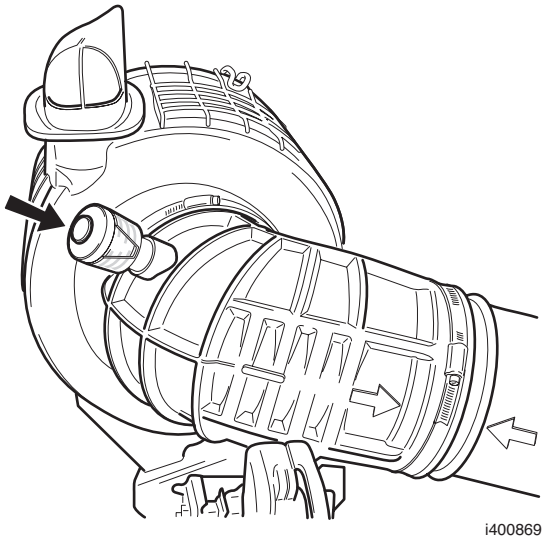
Removing the air filter element

1. Loosen all the clamping brackets (1) of the air filter cover (2).
2. Remove the air filter cover (2).
3. Remove the air filter element (3).
4. Clean the inside of the air filter housing and the air filter cover.



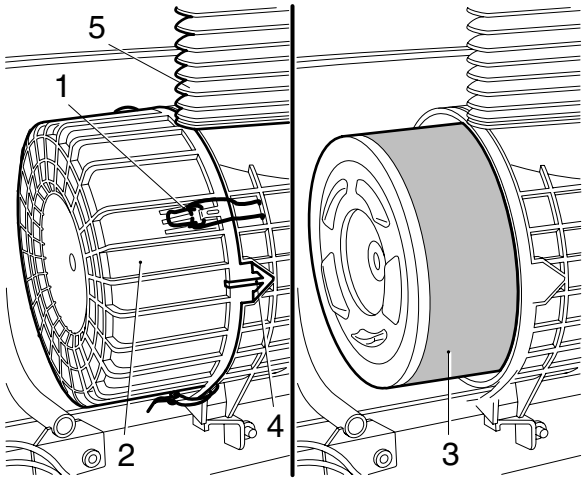
i400443

5. When replacing the air filter element, reset the air filter indicator, if fitted, by pressing the button on the indicator.


i400869

Installing the air filter element

1. Fit the air filter element (3) in the air filter housing.
2. Fit the air filter cover. Note the arrow (4) on the air filter cover (2).
3. Fit all the clamping brackets (1).
4. Check that the flexible sealing bellows (5) on the air intake is not damaged. Replace if necessary.



i400443

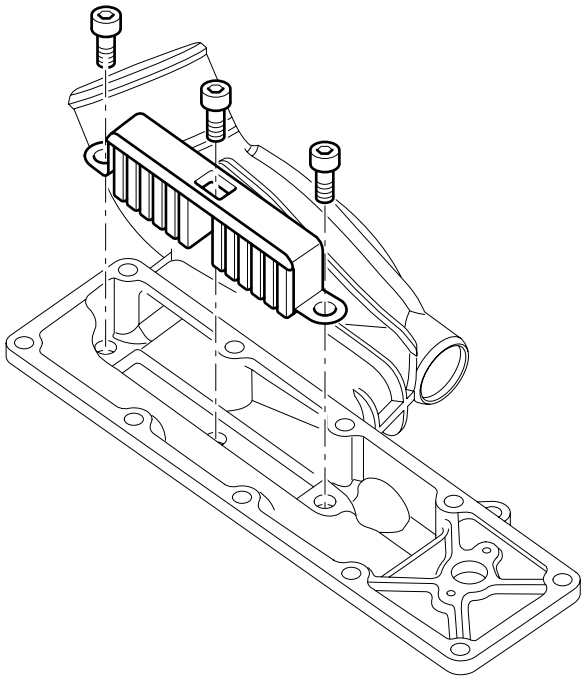
4.4 REMOVAL AND INSTALLATION, GLOW PLUG

Removing the glow plug

1. Remove the inlet manifold.
2. Remove the attachment bolts from the glow plug and remove the glow plug.

Installing the glow plug

1. Fit the glow plug and tighten the attachment bolts to the specified torque. See "Technical data".
2. Fit the inlet manifold.



M201155

5. CLEANING

5.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER

Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

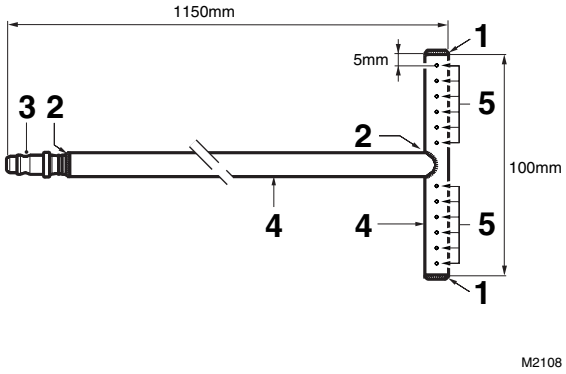
1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.
This tool can be made in your own workshop. It cannot be ordered from DAF.

Key to drawing:

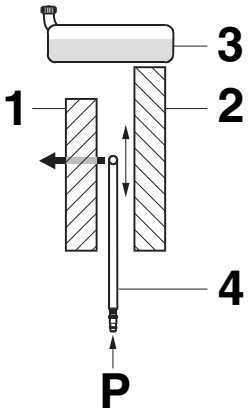
1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, ø 10 mm
5. 6 x ø 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side



M2108

Note:
Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

1. From below, insert the radiator cleaner (4) between the air cooler (1) and the radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.

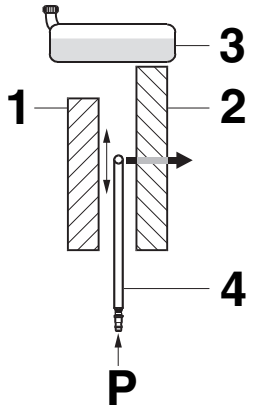


M2109

3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).

4. Fit the wire mesh.

5. Install the lower grille.



M2110

© 200416

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200416
1.1	Safety instructions	1-1	200416
2.	**GENERAL**	2-1	200416
2.1	Location of exhaust brake components	2-1	200416
2.2	System description, exhaust brake	2-2	200416
3.	**INSPECTION AND ADJUSTMENT**	3-1	200416
3.1	Inspection and adjustment, exhaust brake	3-1	200416
4.	**REMOVAL AND INSTALLATION**	4-1	200416
4.1	Removal and installation of exhaust brake	4-1	200416

4

© 200416

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

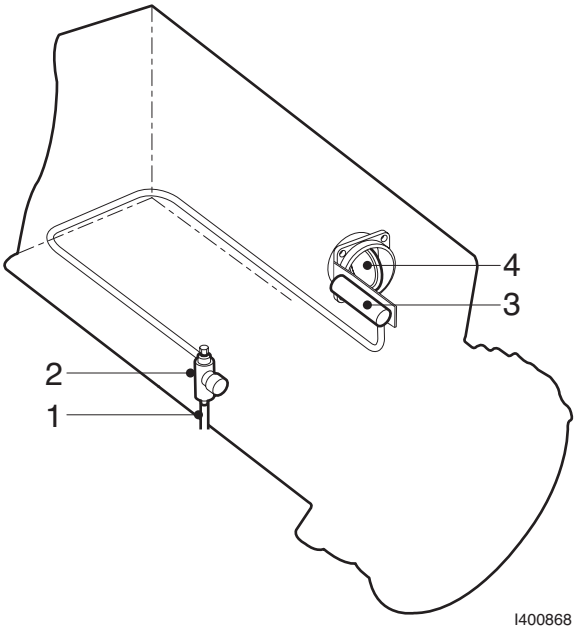
Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

© 200416

2. GENERAL

2.1 LOCATION OF EXHAUST BRAKE COMPONENTS

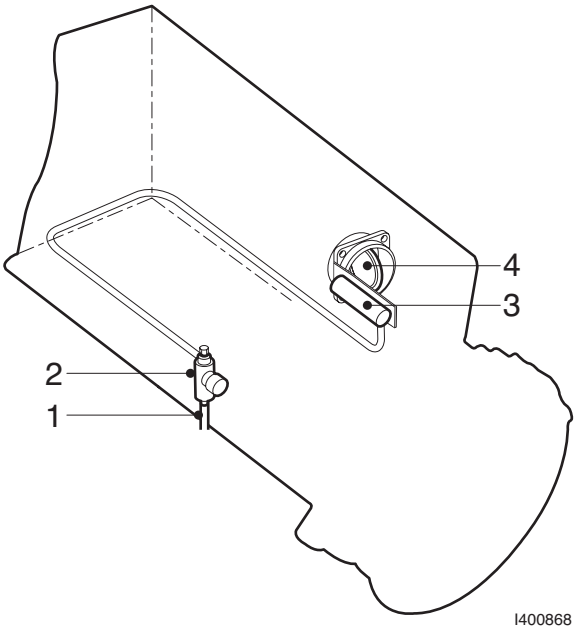
1. Supply pressure
2. Exhaust brake valve
3. Operating cylinder, exhaust brake
4. Butterfly valve



2.2 SYSTEM DESCRIPTION, EXHAUST BRAKE

1. Supply pressure
2. Exhaust brake valve
3. Butterfly valve operating cylinder
4. Butterfly valve

Note:
The engine brake is an exhaust brake.



Switching on the exhaust brake
The exhaust brake consists of an engine brake operating switch fitted in the cab floor and an operating cylinder (3) connected to the butterfly valve (4) in the exhaust pipe.
If the engine brake operating switch is activated, a signal is passed to the engine management system's electronic unit. The engine management system's electronic unit interrupts the fuel supply to the various cylinders. The unit also energises the exhaust brake valve (2), causing supply pressure to flow to the operating cylinder. This cylinder closes the butterfly valve in the butterfly valve housing. The exhaust pipe is then almost completely closed off.
The engine now acts as a compressor, creating a braking action.
The higher the engine speed, the greater the braking action of the exhaust brake.

Switching off the exhaust brake
If the engine brake operating switch is released, the butterfly valve will be re-opened and the fuel supply to the various cylinders will be re-instated.

3. INSPECTION AND ADJUSTMENT

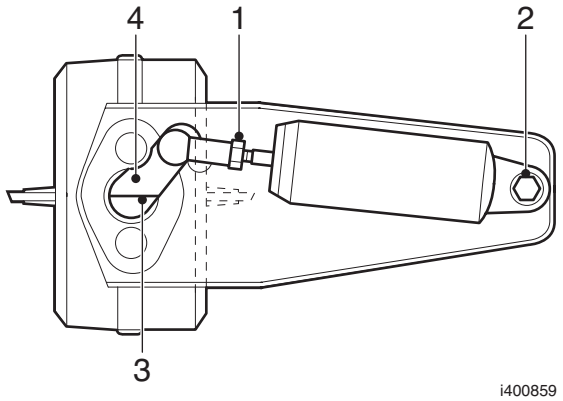
3.1 INSPECTION AND ADJUSTMENT, EXHAUST BRAKE

Checking exhaust brake

1. Check the exhaust brake for smooth operation by pressurising the exhaust brake cylinder yourself.

Setting the exhaust brake

1. Remove the air pipe from the operating cylinder.
2. Slacken lock nut (1) on the piston rod.
3. Remove the attachment nut (2) from the operating cylinder and take the operating cylinder off the support.
4. Open the butterfly valve fully (exhaust brake inactive), indicated by the mark (3) on the butterfly valve shaft, and press the lever (4) against the stop.
5. Set the piston rod length by rotating the operating cylinder in such a way that it can be fitted on the support.
6. Turn the piston rod one more full turn in the ball joint to give the operating cylinder the correct pre-tension.
7. Fit the operating cylinder on the support using the attachment nut (2) and fit the air pipe.
8. Tighten the lock nut (1).
9. Connect the air pipe to the operating cylinder.



i400859

© 200416

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION OF EXHAUST BRAKE

Removing the exhaust brake

1. Loosen the air pipe of the operating cylinder.
2. Remove the exhaust pipe from the exhaust brake.
3. Remove the entire exhaust brake.

Installing exhaust brake

1. Check the butterfly valve for smooth operation.
2. Clean and check the sealing faces of the butterfly valve housing and of the exhaust pipes.
3. Clean the attachment bolts and apply heat-resistant grease to the threads.
4. Fit the exhaust brake.
5. Fit the exhaust pipe.
6. Connect the air pipe.
7. Check the operation of the exhaust brake.

© 200416

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of components	2-1	200324
2.2	System description, UPEC fuel system	2-2	200324
2.3	Description of components	2-7	200324
2.4	Cranking the engine	2-12	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspecting fuel level element	3-1	200324
3.2	Inspecting injector opening pressure	3-3	200324
3.3	Inspecting injector operation	3-5	200324
3.4	Inspecting fuel system for leakage	3-6	200324
3.5	Bleeding the fuel system	3-8	200324
3.6	Inspection, gallery pressure	3-10	200324
3.7	Checking the fuel prefilter/water separator	3-11	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation, fuel injection pipe	4-1	200324
4.2	Removal and installation, injector	4-3	200324
4.3	Removal and installation, injector sleeve	4-5	200324
4.4	Removal and installation, pump unit	4-6	200324
4.5	Removal and installation, fuel lift pump	4-8	200324
4.6	Removal and installation, pump housing	4-9	200324
4.7	Removal and installation, fuel pipes	4-13	200324
4.8	Removal and installation, fuel filter element	4-14	200324
4.9	Removal and installation, fuel level element	4-15	200324
4.10	Removal and installation, fuel tank filter	4-16	200324
4.11	Removal and installation, fuel prefilter/water separator filter element	4-18	200324
5.	**DISASSEMBLY AND ASSEMBLY**	5-1	200324
5.1	Disassembly and assembly, pump housing	5-1	200324
6.	**CLEANING**	6-1	200324
6.1	Cleaning, injector	6-1	200324
6.2	Cleaning, injector sleeve	6-2	200324

5

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

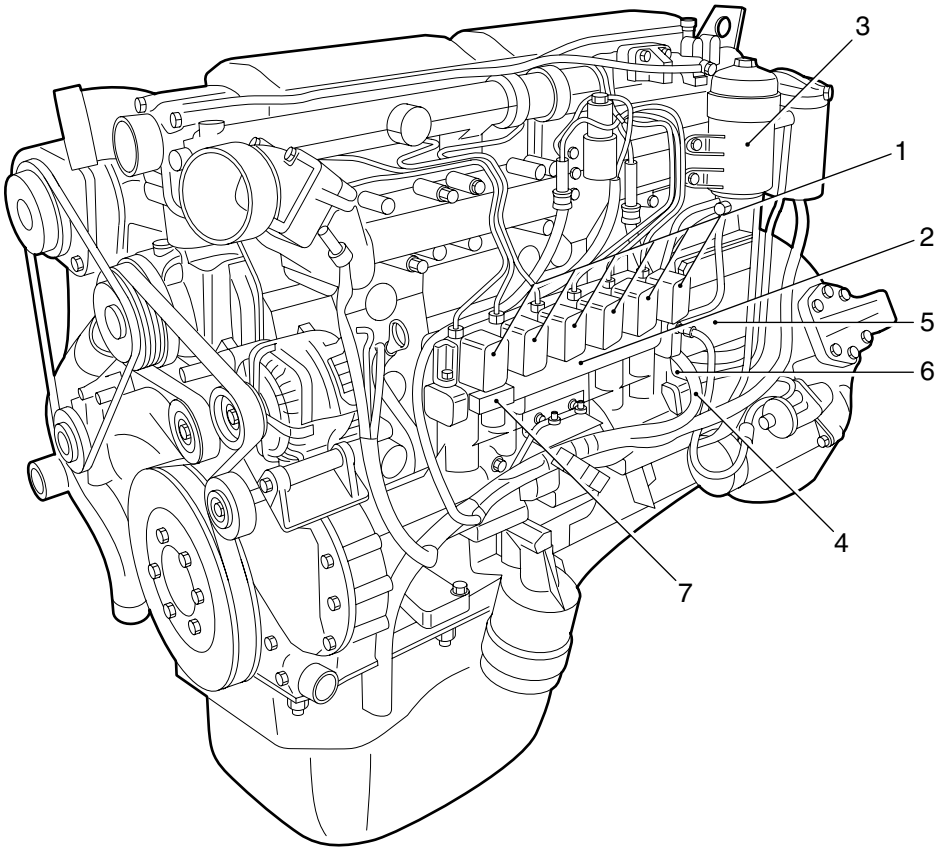
Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

5

© 200324

2. GENERAL

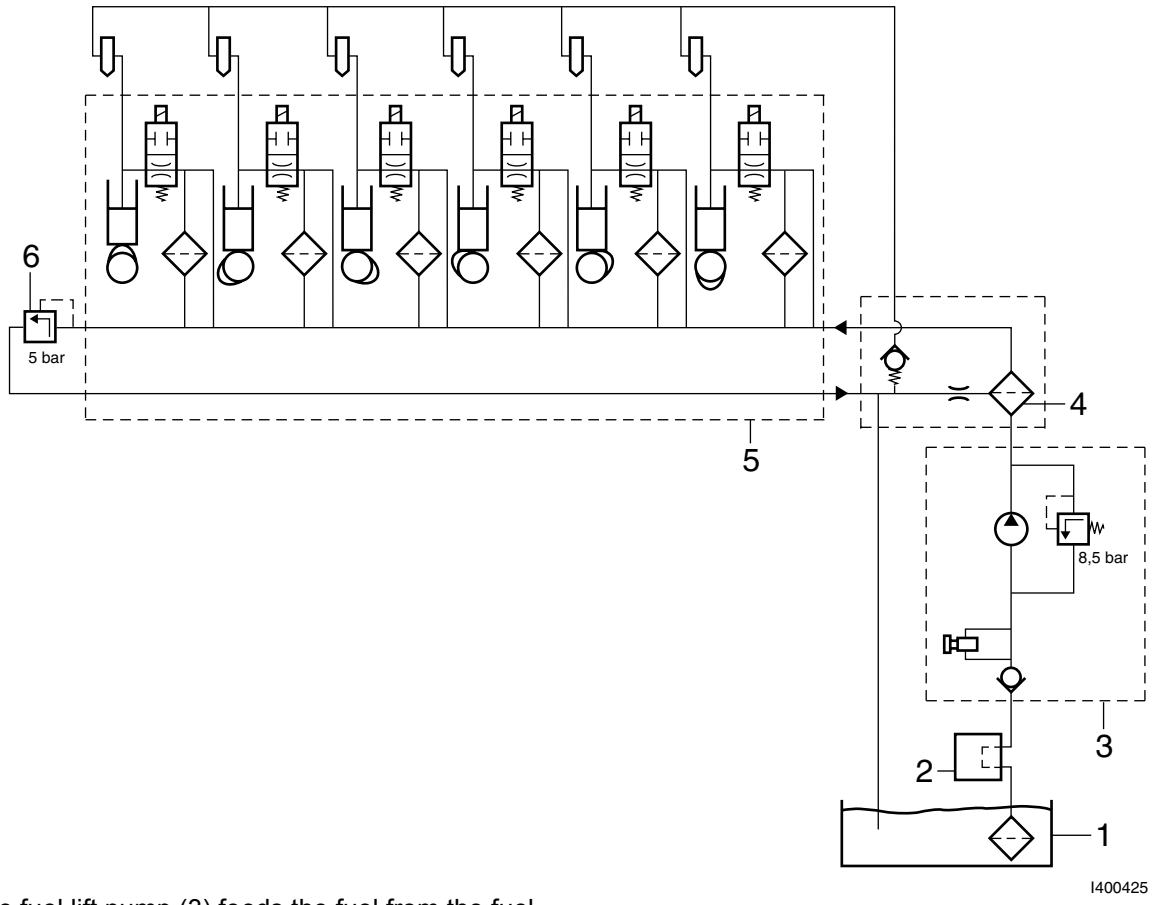
2.1 LOCATION OF COMPONENTS



i4 00 684

1. Pump units
2. Pump housing
3. Fuel fine filter
4. Fuel lift pump
5. UPEC electronic unit
6. Primer pump
7. Pressure relief valve

2.2 SYSTEM DESCRIPTION, UPEC FUEL SYSTEM



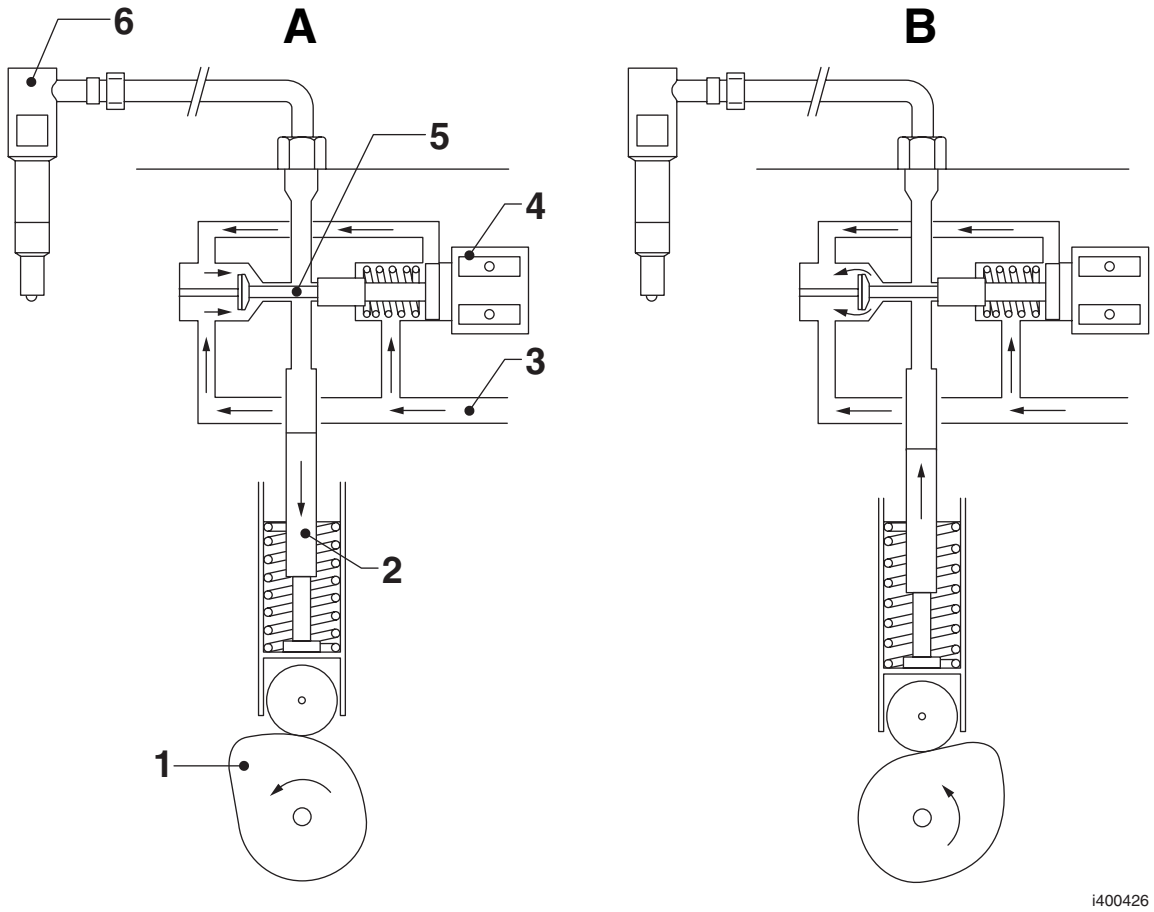
The fuel lift pump (3) feeds the fuel from the fuel tank (1) through the cooling plate (2).
The purpose of the cooling plate (2) is to ensure that the electronic unit does not become too hot.
The fuel lift pump (3) is fitted opposite the pump housing (5) and is driven by the camshaft in the pump housing.
From the fuel lift pump, fuel is forced towards the fuel fine filter (4).
For the purpose of constant bleeding, there is a calibrated bore in the fuel fine filter.
After the filter, the fuel enters the pump housing (5).
The pump units driven by the electronic unit are fitted in the pump housing (5).
The pump units force the fuel at high pressure (approx. 1600 bar) to the injectors.

At the end of the supply channel, there is a pressure relief valve (6) that connects the supply and discharge channels at a specific supply channel pressure. The pressure relief valve ensures a good degree of filling for the pump units. The discharge channel is connected to the fuel tank (1) return pipe via the fuel fine filter.

The injector leak-off pipe is connected to the return pipe to the fuel tank (1) via a non-return valve in the fuel fine filter.

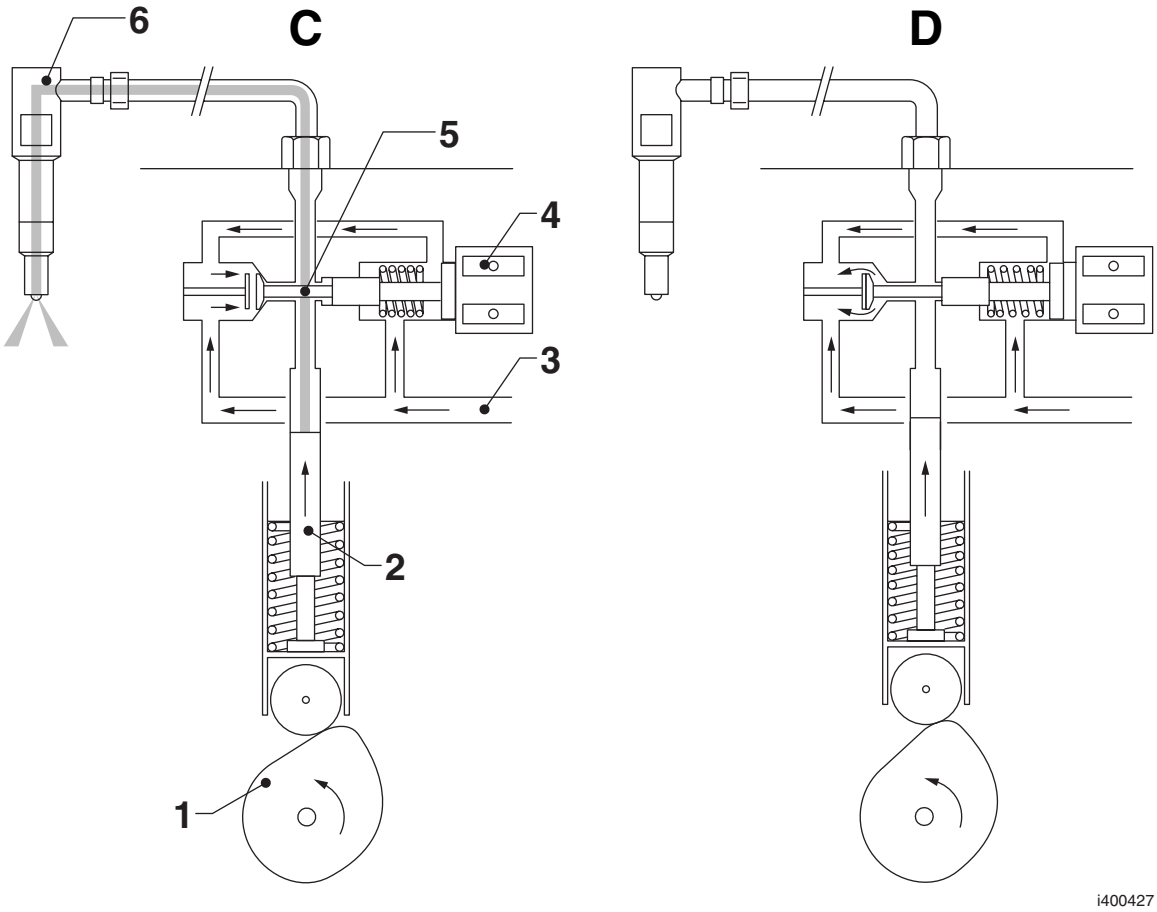
If the system has been 'open', the fuel system can be bled by means of the integrated primer pump in the fuel lift pump (3).

Pump unit
Operating principle



Situation A
In this situation the pump plunger (2) makes the suction stroke.
Due to the constant overpressure in the supply area of the fuel system, the high-pressure area above the pump plunger (2) is filled via the fuel supply ducts (3).

Situation B
In this situation the pump plunger (2) makes the compression stroke.
As the valve (5) has not yet closed the link to the fuel supply ducts (3), there is no pressure build-up.



Situation C
In this situation, the injection timing is determined.
The solenoid valve (4) is activated by the electronic unit.
In this way, the valve (5) closes the link between the space above the pump plunger (2) and the fuel supply ducts (3).
There is now a pressure build-up above the pump plunger (2), causing fuel to be injected via the injector (6).

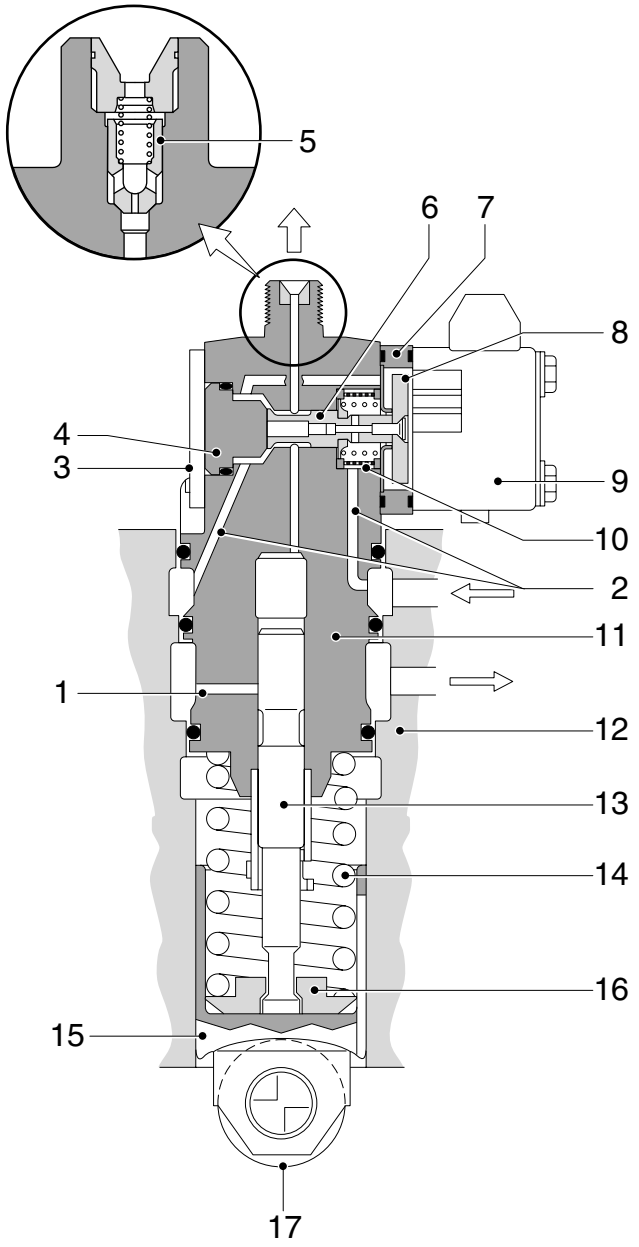
Situation D
In this situation the quantity of fuel to be injected is determined.
The solenoid valve (4) is no longer activated by the electronic unit
The valve (5) opens the connection between the space above the pump plunger (2) and the fuel supply ducts (3).
The fuel pressure above the pump plunger (2) will be quickly reduced.

The valve (6), back plate (8) and the pump plunger (13) are located in the top of the pump unit.
These parts are lubricated by the fuel.
A roller (17), tappet (15) and a spring (14) with spring retainer (16) are situated on the bottom of the pump unit.
These parts are lubricated by the engine lubrication system.
The lower sealing ring on the pump unit separates the fuel system from the engine lubrication system.

A pressure valve (5) is fitted on the top of the pump unit.
The function of the pressure valve is to prevent the supply section from being interrupted by pressure peaks from the injector pipe.

The injection timing and the quantity of fuel to be injected are controlled by a solenoid valve (9) that consists of an electromagnet and valve (6) with back plate (8), via the electronic unit control.

If the solenoid valve (9) is not energised, the valve (6) is forced against the valve stop (4) by the force of the valve spring.
This creates a very small opening between the space above the pump plunger (13) and the supply ducts (2).



i 400434

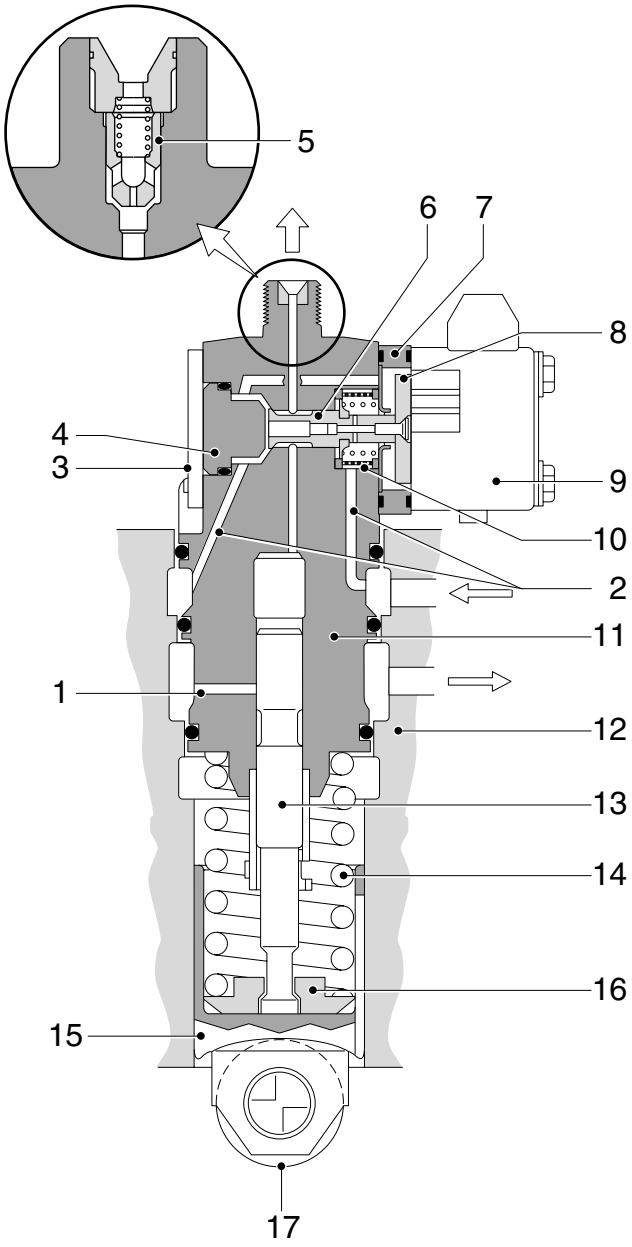
5

If the solenoid valve (9) is energised by the electronic unit, the back plate (8) with the valve (6) will be attracted by the electromagnet due to the influence of the magnetic field.
The valve (6) closes the connection between the space above the pump plunger (13) and the supply ducts (2), causing pressure to build up in the space above the plunger (13).
This causes the injection.

The fuel will now flow via the fuel supply ducts (2) to the space above the pump plunger (13).

The valve (6) is not re-opened against the force of the magnet by the high-pressure in the high-pressure area, as the forces in the valve (6) slot are balanced.
In other words, the left and right surfaces in the valve (6) slot are equal.

The time at which the valve (6) shuts depends on the injection timing calculated by the electronic unit.
The time that the valve (6) remains closed, and therefore the quantity of fuel injected, is also calculated by the electronic unit.

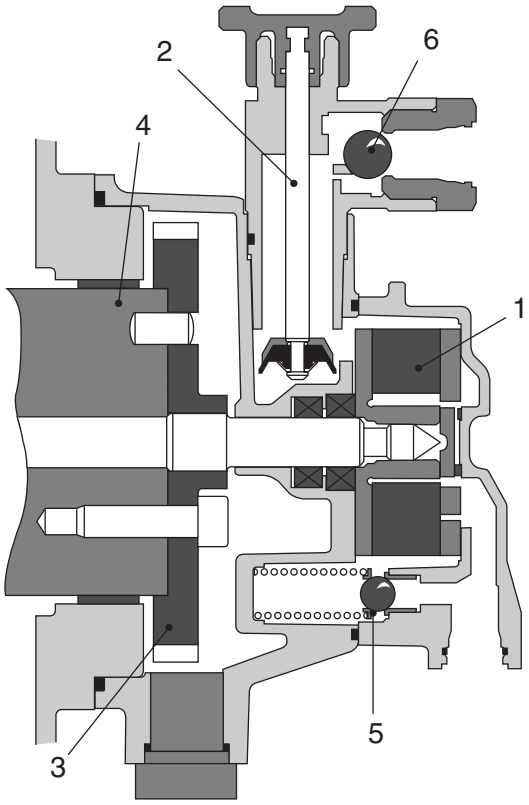


i 400435

2.3 DESCRIPTION OF COMPONENTS

Fuel lift pump with integrated primer pump

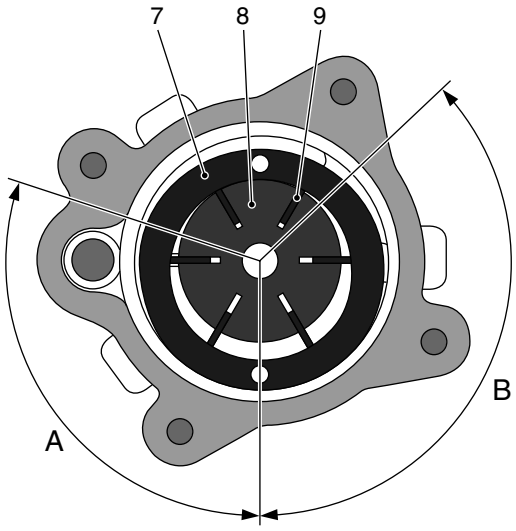
The fuel lift pump with integrated primer pump is fitted to the rear of the pump housing. The fuel lift pump section (1) is driven via the pulse plate (3) by the camshaft (4) in the pump housing.
The fuel lift pump (1) is a vane pump.



I400428

The vane pump consists of a stator (7) in which the rotor (8) with the vanes (9) can be found. The vanes (9) are forced against the surface of the stator (7) by the centrifugal force and two successive vanes form an enclosed space, the pump chamber. Due to the elliptically-shaped stator (7), with each revolution each pump chamber undergoes a volume increase, the suction stroke (angle A), a volume reduction and the compression stroke (angle B).
To achieve a good seal, the rear of the vanes are connected to the compression pipe of the pump. This forces the vanes against the stator with increased pressure, resulting in a good seal.

A pressure-relief valve (5) is fitted in the fuel lift pump to protect the fuel system against excessive fuel lift pump pressure caused by excessive flow resistance.



i 400433

Note:
Excessive fuel lift pump pressure may damage the fuel filter element and/or leakage may occur along seals.

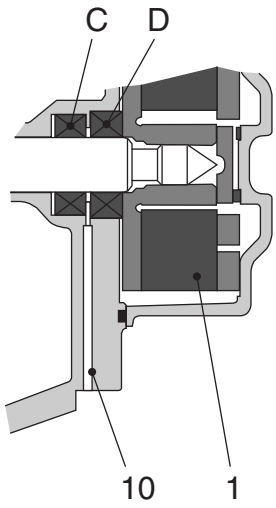
A primer pump (2) is fitted for bleeding the fuel system. To operate the primer pump (2), it must first be loosened.

On the upward stroke, the volume above the priming pump piston is reduced. This causes the non-return valve (6) to close and the fuel flows along the piston seal to the bottom of the piston.

On the downward stroke, the volume below the priming pump piston is reduced. This forces the fuel via the fuel lift pump section to the fuel fine filter.

5

At the bottom of the fuel lift pump is a pressure-relief area (10).
The pressure-relief area prevents fuel penetrating the lubrication system through sealing ring C and lubricating oil penetrating the fuel system through sealing ring D in the event of leakage.
A visual inspection for leaks is also possible with this.



I400432

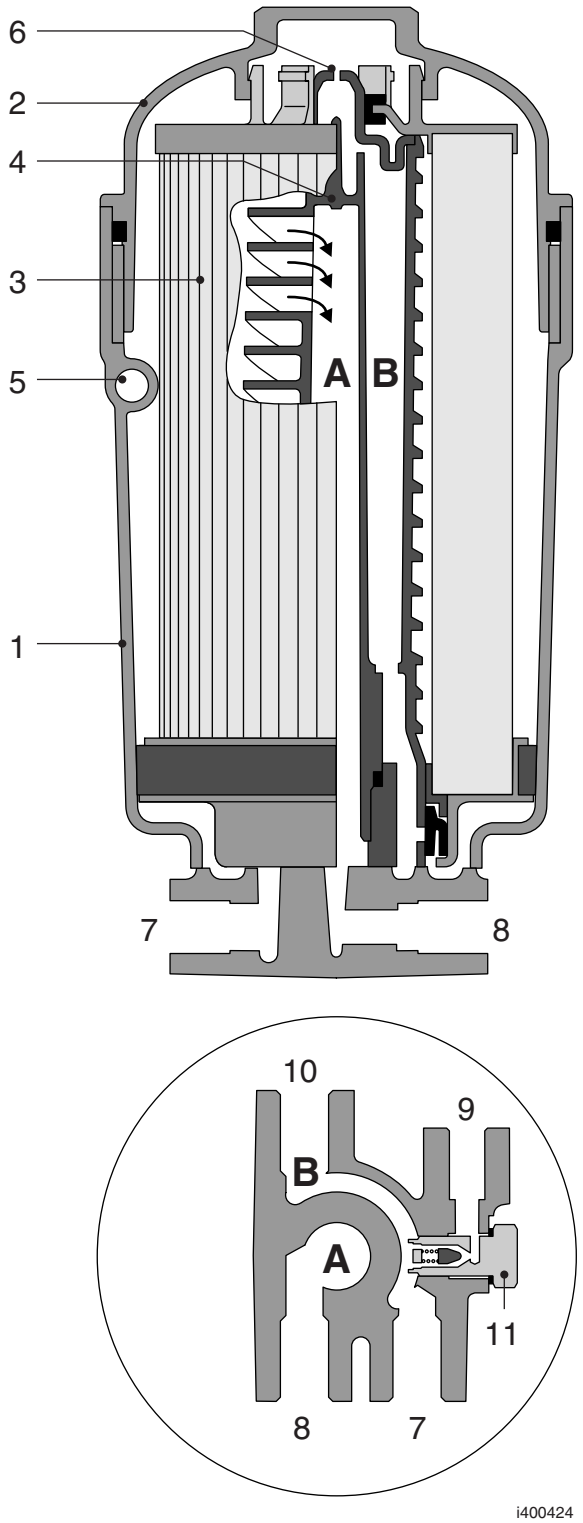
Fuel filter

The fuel filter consists of a filter housing (1) with a screw cap (2) in which the filter element (3) is secured. The inner section of the filter housing contains a central tube (4) with a supply side (A) and a permanent bleed side (B).

The fuel enters via connection (5) and is forced through the filter element (3). Within the filter element is the central tube (4) with the supply side (A) and a permanent bleed side (B). Via bores in the supply side (A), the filtered fuel passes to the pump housing.

A small section of the fuel and any air present enters via a calibrated hole (6) on the top of the central tube (4) in the permanent bleed side (B) and is led to the bottom of the filter housing.

At the bottom of the filter housing, a small amount of fuel and any air present are mixed with the leak-off fuel from the injectors (9) and the excess fuel from the pump housing (10). In the connection of the injector leak-off pipe is a banjo bolt with an integrated non-return valve (11). From the bottom of the filter housing, the excess fuel and any air present go back to the tank (7).

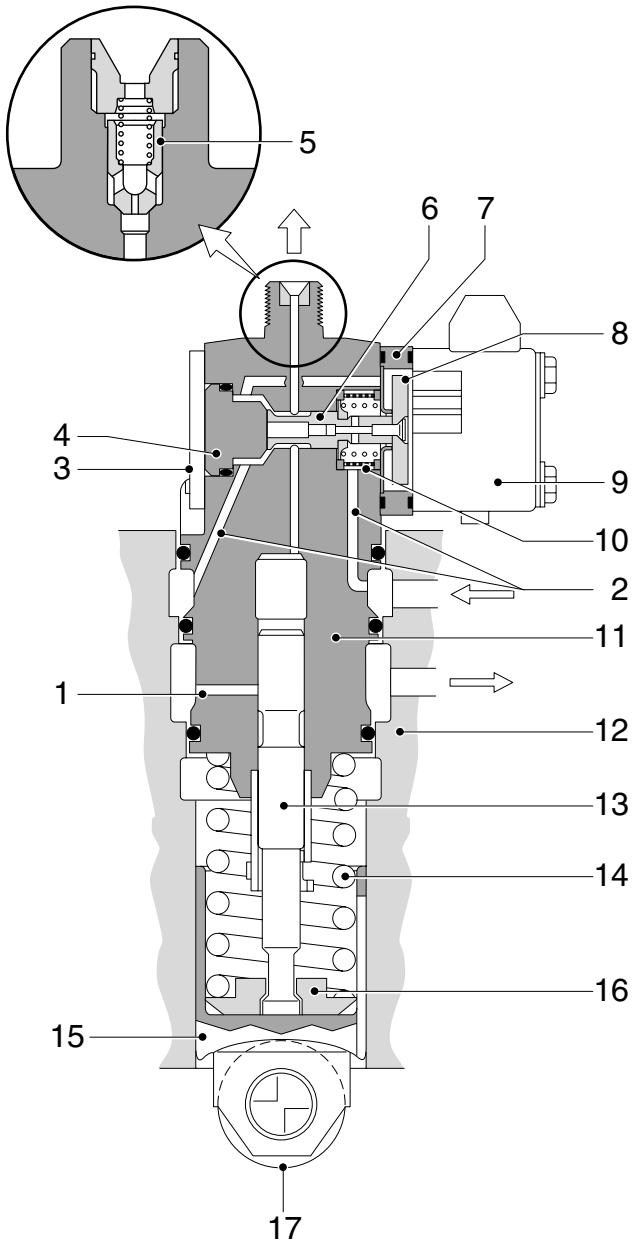


Pump unit
The valve (6), back plate (8) and the pump plunger (13) are located in the top of the pump unit.
These parts are lubricated by the fuel.
A roller (17), tappet (15) and a spring (14) with spring retainer (16) are situated on the bottom of the pump unit.
These parts are lubricated by the engine lubrication system.
The lower sealing ring on the pump unit separates the fuel system from the engine lubrication system.
A pressure valve (5) is fitted on the top of the pump unit.
The function of the pressure valve is to prevent the supply section from being interrupted by pressure peaks from the injector pipe.

The injection timing and the quantity of fuel to be injected are controlled by a solenoid valve (9) that consists of an electromagnet and valve (6) with back plate (8), via the electronic unit control.

If the solenoid valve (9) is not energised, the valve (6) is forced against the valve stop (4) by the force of the valve spring.
This creates a very small opening between the space above the pump plunger (13) and the supply ducts (2).

The fuel will now flow via the fuel supply ducts (2) to the space above the pump plunger (13).

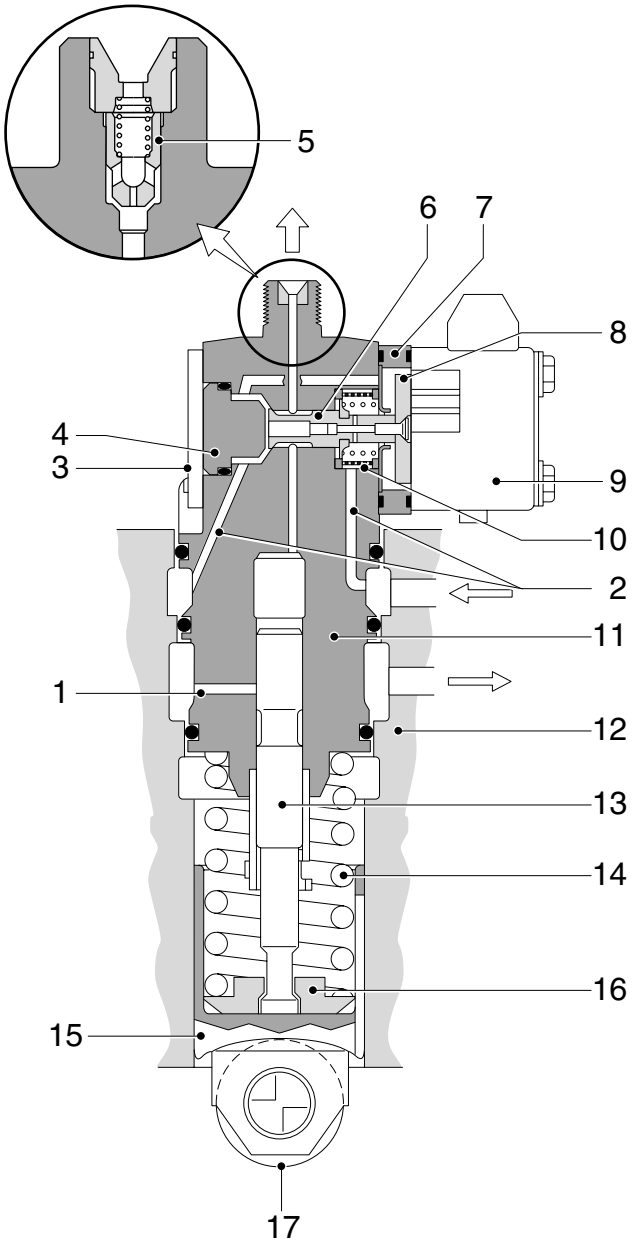


i 400434

If the solenoid valve (9) is energised by the electronic unit, the back plate (8) with the valve (6) will be attracted by the electromagnet due to the influence of the magnetic field.
The valve (6) closes the connection between the space above the pump plunger (13) and the supply ducts (2), causing pressure to build up in the space above the plunger (13).
This causes an injection.

The valve (6) is not re-opened against the force of the magnet by the high-pressure in the high-pressure area, as the forces in the valve (6) slot are balanced.
In other words, the left and right surfaces in the valve (6) slot are equal.

The time at which the valve (6) shuts depends on the injection timing calculated by the electronic unit.
The time that the valve (6) remains closed, and therefore the quantity of fuel injected, is also calculated by the electronic unit.

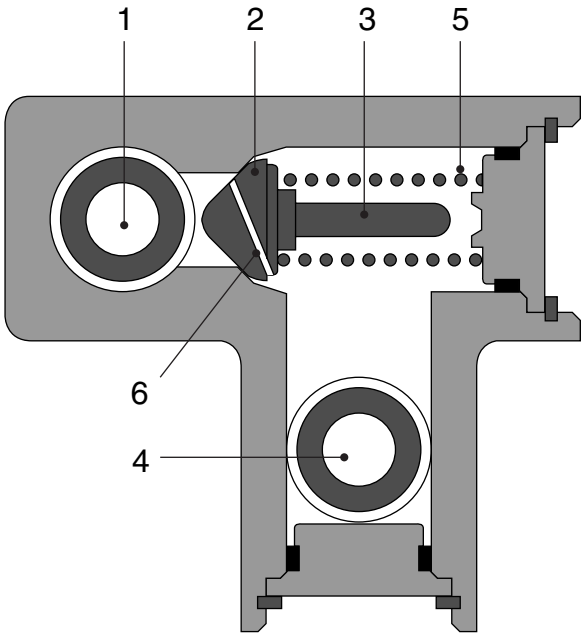


i 400435

Pressure relief valve
To guarantee a good degree of filling of the pump units, the end of the supply channel has a pressure-relief valve.
The pressure-relief valve connects the supply channel to the discharge channel.

The fuel flows into the entrance (1), past the piston (2) and the guide pin (3) and to the exit (4). The fuel encounters resistance due to the presence of the spring (5). This results in a pressure-relief valve opening pressure of approx. 5 bar.

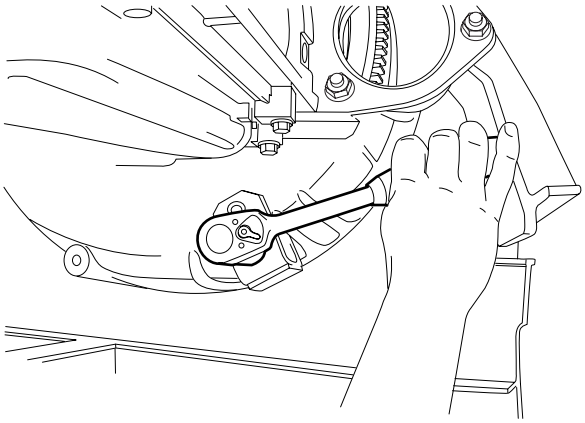
The piston (2) has a diagonal bore (6). This bore is fitted for bleeding the fuel system.



i400423

2.4 CRANKING THE ENGINE

Cranking on the flywheel housing
1. Place the special tool (DAF no. 1310477) on the opening at the bottom of the flywheel housing such that the pinion engages the starter ring gear.
2. Turn the crankshaft clockwise as seen from the timing gear end (this corresponds to the direction of rotation of the engine).


M201187

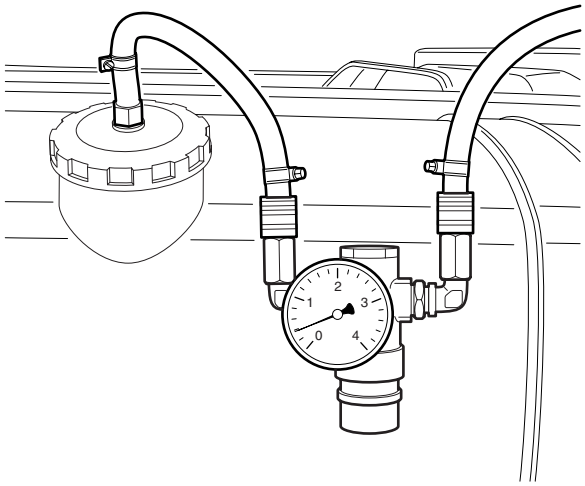
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTING FUEL LEVEL ELEMENT

To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

1. Fit a pressure reducer valve connection on a tank cap (without bleeder) and connect the tank cap to the fuel tank.
2. Pressurise the fuel tank (**maximum 0.1 bar**).
3. Slowly increase the pressure until the system audibly blows off via the pressure relief valve and check the opening pressure of the fuel level element. See "Technical data".
4. De-pressurise the fuel tank and remove the tank cap with the air connection.

   Note:
   To prevent dirt from entering, first clean the exterior of the fuel tank.

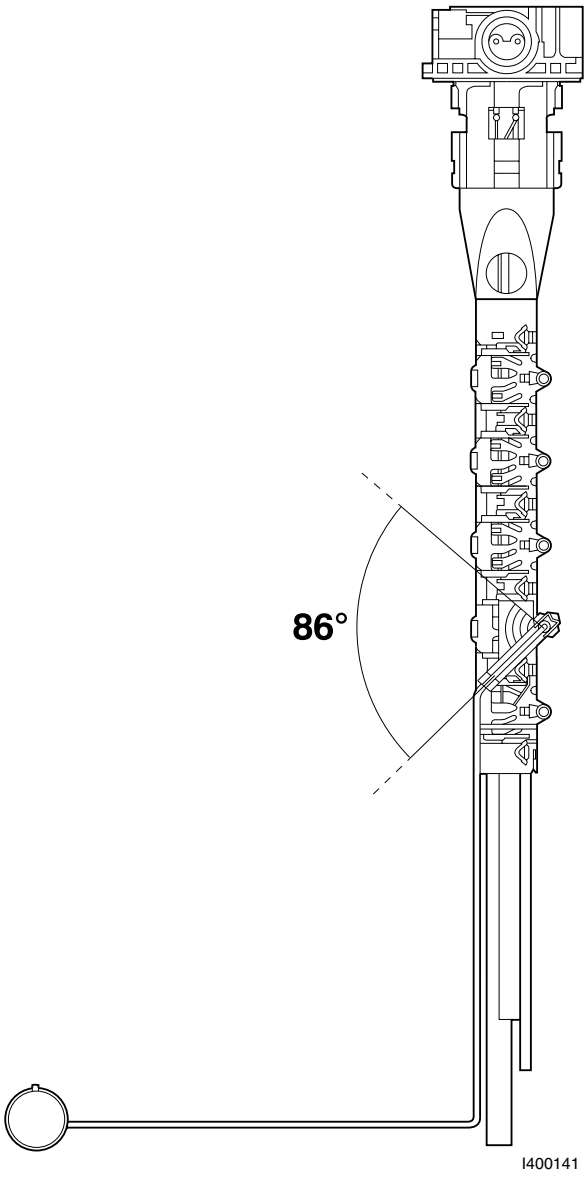


i400600

5

5. Remove the fuel level element.

6. Check the angular displacement of the fuel level element and the resistor value. See "Technical data".



© 200324

3.2 INSPECTING INJECTOR OPENING PRESSURE

Fuel or test fluid discharged by an injector may penetrate the skin, seriously harming your health. Make sure the fuel jet is discharged into a suitable container.

1. Disconnect the earth lead from the battery terminal.

2. Remove the fuel injector pipes as a set and close the connections on the pump units immediately.

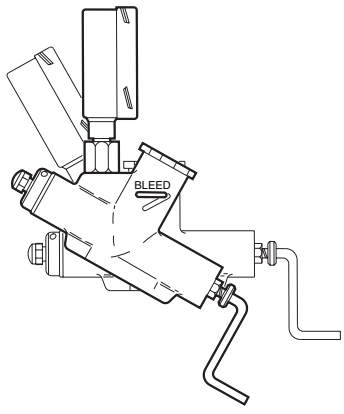
   Note:
   The opening pressure of the injectors can be tested using an injector test pump (DAF no. 0694966). The advantage of this method is that the injectors need not be removed from the engine.

3. Check the opening pressure of the injectors.

Instructions for the use of the injector test pump

1. Before the injector test pump is used, it must first be bled.
   Remove the pump reservoir filler plug and fill the reservoir with test fluid. The fluid level must be approximately 1 cm below the top rim.

2. Tilt the pump until the line with the word **"BLEED"** is horizontal.

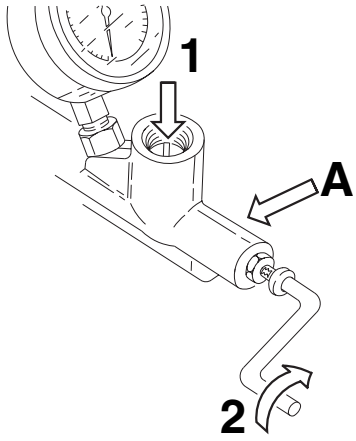


M4059

3. Press the bleed pin (1) and simultaneously turn the crank (2) clockwise to the stop. During this procedure, air bubbles will come to the surface in the reservoir. Now turn back the crank, fill the reservoir again and repeat the process until no more air bubbles come to the surface.
   Now release the bleed pin. Continue turning the crank until fuel escapes on the delivery side.

4. If necessary, fill the fuel reservoir and screw back the cap.

5. The pump is now ready for use.



M4058

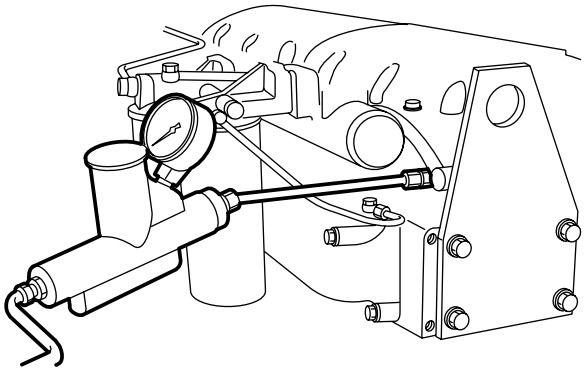
Inspecting opening pressure with an injector test pump

1. Keep the test pump more or less horizontal.

2. Loosen the test pump filler cap by half a turn so that air can enter the reservoir.

3. Turn the test pump crank clockwise. The compression will now start. Watch the fluid level in the test pump.

4. Carefully determine the opening pressure of the injector. There is no harm in repeating the test two or three times.


i 400190

If the test is repeated too often, however, the test fluid deposited on the piston may cause damage to the engine when it is started.

3.3 INSPECTING INJECTOR OPERATION

Fuel or test fluid discharged by an injector may penetrate the skin, seriously harming your health. Make sure the fuel jet is discharged into a suitable container.

Evaluating the injector's spray pattern, spray angle, and sound is practically impossible. New injectors or injectors that have been in use for some time cannot be tested in this way.

1. Place the injector on an injector tester.

2. First allow the injector to inject a number of times.

3. Inspect the injector for:
   - opening pressure
   - leakage
   - injector nozzles.

Opening pressure

1. Inspect the discharge pressure by slowly building up the pressure inside the injector.

Leakage

1. Dry the nozzle immediately after the final injection.

2. Increase the pressure to the opening pressure minus 20 bar. Within approx. 10 seconds, fuel must have ceased to leak from the nozzle. A moist nozzle is permitted. If the injector does not pass the oil leakage test, it must be replaced.

Injector nozzles

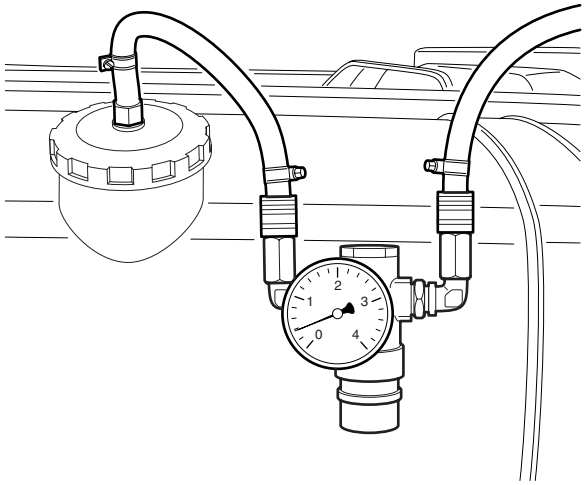
1. Quickly build up pressure in the injector and check whether all the nozzles are fully open.

2. Clean the injector if possible. See "Cleaning".

3.4 INSPECTING FUEL SYSTEM FOR LEAKAGE

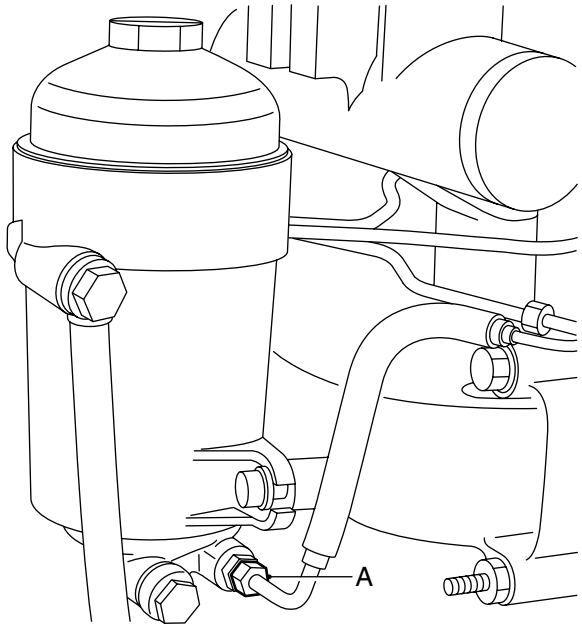
To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

1. Fit a pressure reducer valve connection on a tank cap (without bleeder) and connect the tank cap to the fuel tank.
2. Dry the inspection points.
3. Pressurise the fuel tank (maximum 0.2 bar).



i400600

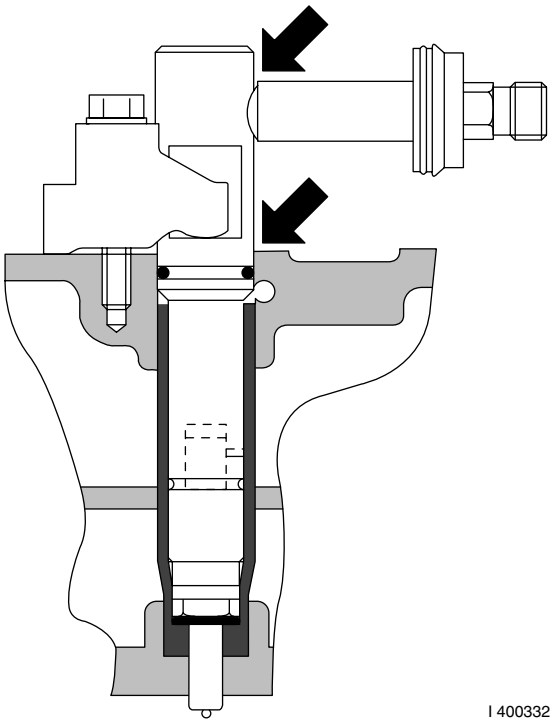
4. Unscrew the union nut (A) a few turns to check whether there is leakage in the non-return valve. If there is leakage, the banjo bolt should be replaced.
5. Check the whole fuel system (low-pressure section) for leaks.
6. De-pressurise the system and replace the banjo bolt with integrated non-return valve on the rear of the filter housing with a normal banjo bolt.



M201115

7. Remove the valve covers.
8. Re-pressurise the system (maximum 0.2 bar).
9. Check the permeable seal and the side-connection of the injectors for leaks.

   Note:
   Engine oil may be used to detect leaks at the O-ring.
10. Fit the valve covers.
11. Replace the normal banjo bolt with a banjo bolt with integrated non-return valve.



I 400332

3.5 BLEEDING THE FUEL SYSTEM

While bleeding the fuel system, fuel will escape. Collect the fuel to avoid the risk of fire.

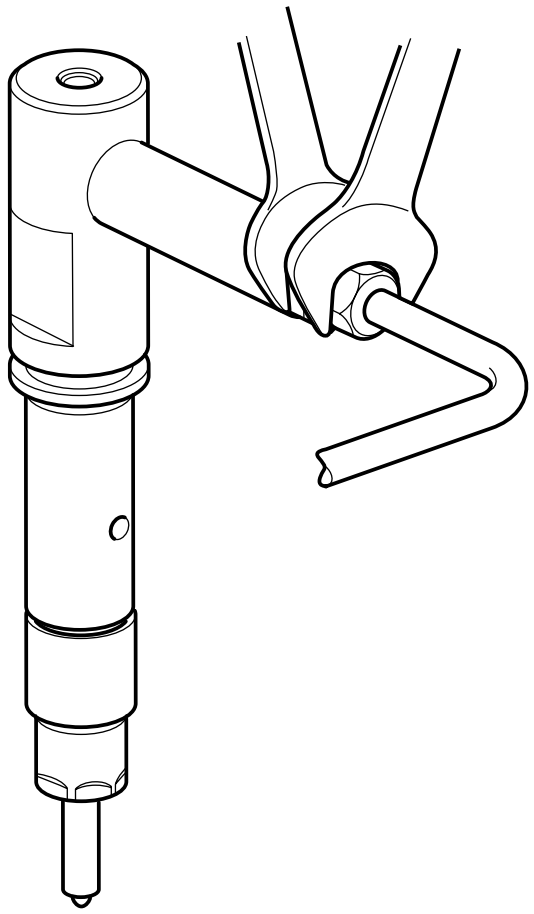
Dirt in the fuel system can lead to significant damage to pump units and housing.

Note:
The fuel system has to be bled if it has been opened; this can be done in two ways.

- With the fuel lift pump
- By pressurising the fuel tank

Bleeding using the fuel lift pump

1. Loosen the union nut on the injector.
2. Pump fuel out of the injector pipe with the primer pump until no more air bubbles are visible in the fuel.
3. Tighten the union nut to the specified torque, see "Technical data".
4. Repeat points 1, 2 and 3 for the other injectors.



i 400237

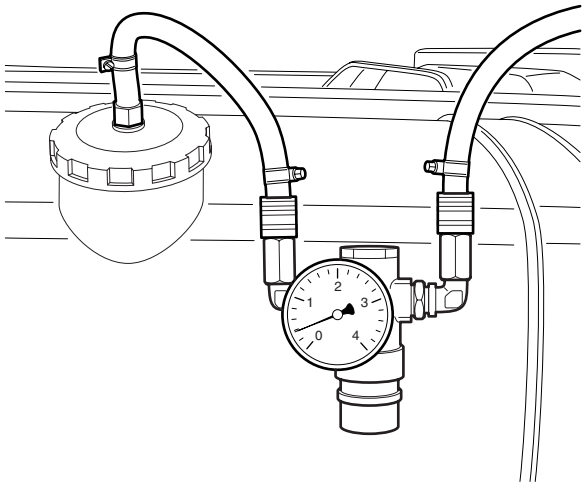
© 200324

Bleeding by pressurising the fuel tank

To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

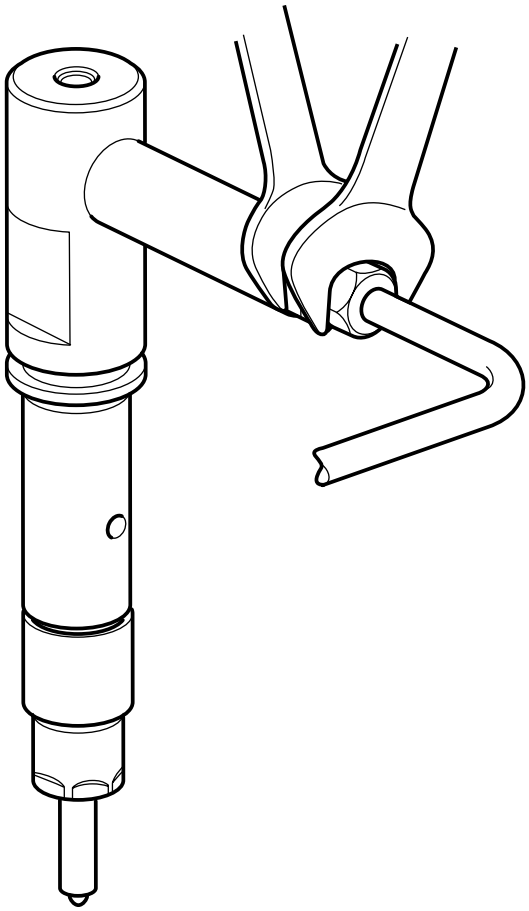
1. Remove the fuel tank cap and replace it by a cap with an adjustable air connection.

   Note:
   Use a cap (without a vent) that has a connection for a pressure reducer valve.



i400600

2. Pressurise the tank to a maximum of 0.2 bar.
3. Loosen the union nut on the injector.
4. Tighten the union nut to the specified torque, see "Technical data".
5. Repeat points 1, 2 and 3 for the other injectors.


i 400237

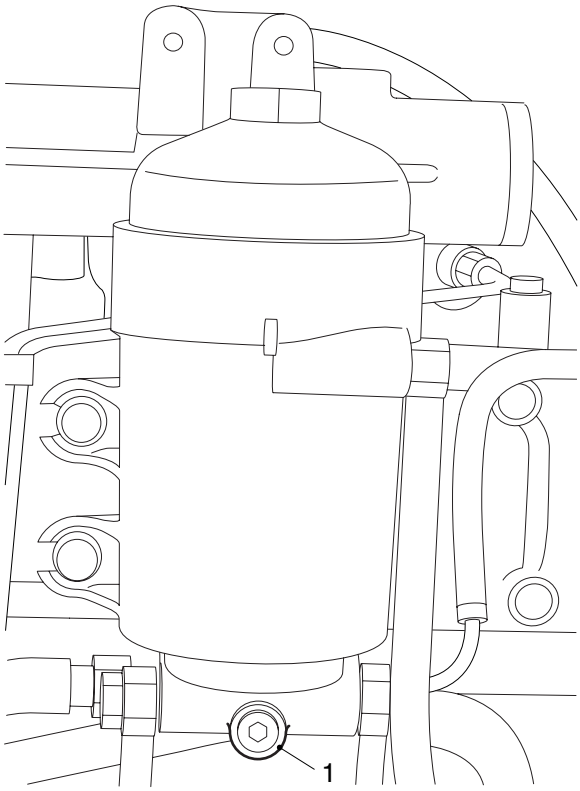
3.6 INSPECTION, GALLERY PRESSURE

When inspecting the gallery pressure, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

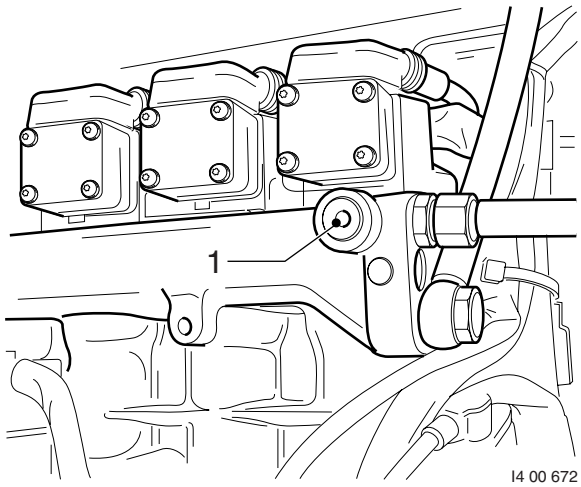
Dirt in the fuel system can lead to significant damage to pump units and housing.

1. Remove the plug (1) from the fuel fine filter or from the pump housing.
2. Connect an attenuated liquid pressure gauge with a range of 0 - 10 bar to the free connection point.

   Note:
   Before inspecting the gallery pressure at the starting speed, the fuses of the UPEC engine management system must be removed from the central box before and after ignition to stop the engine running and avoid fault messages.
3. Then check the gallery pressure at idling speed, full load and starting speed and compare the measured values to the specified values. See "Technical data".
4. Remove the pressure gauge and fit the plug (1).
5. Bleed the fuel system.



i400528



I4 00 672

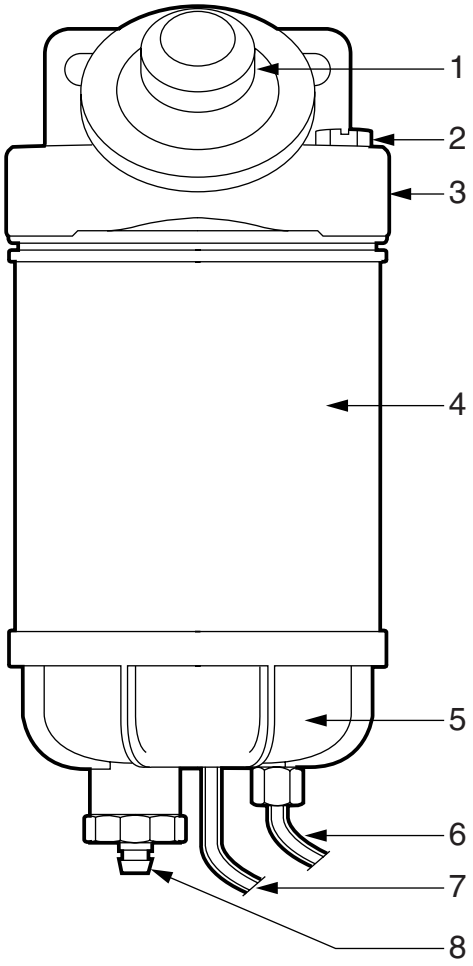
3.7 CHECKING THE FUEL PREFILTER/WATER SEPARATOR

Note:
If a fuel prefilter/water separator is fitted, there are two further versions.

"Racor" version

1. Check the reservoir (5) for water.

2. If necessary, drain the water off through the drain plug (8) using the fuel lift pump (1) and collect the water and fuel in a container.

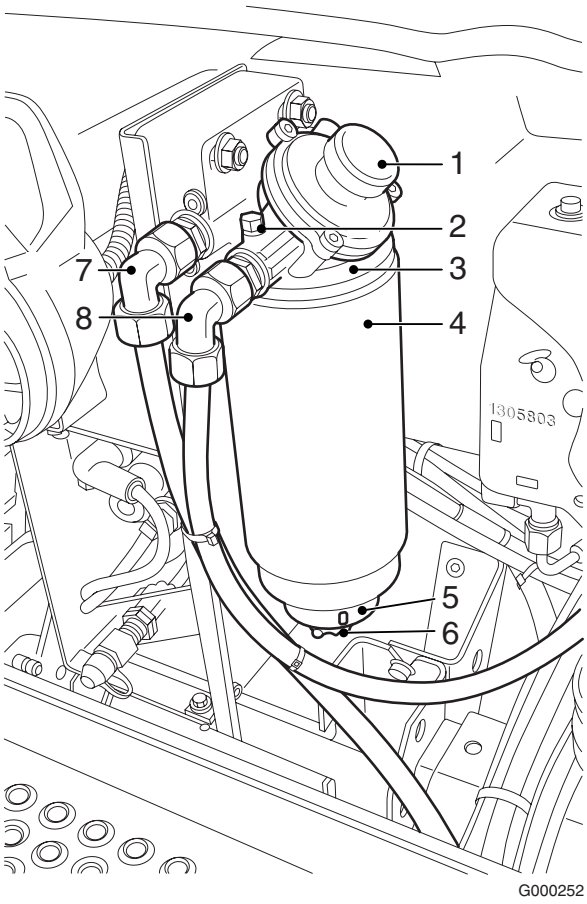


i400356

"Mann & Hummel" version

1. Check the reservoir (5) for water.

2. If necessary, drain the water off through the drain plug (6) using the fuel lift pump (1) and collect the water and fuel in a container.



5

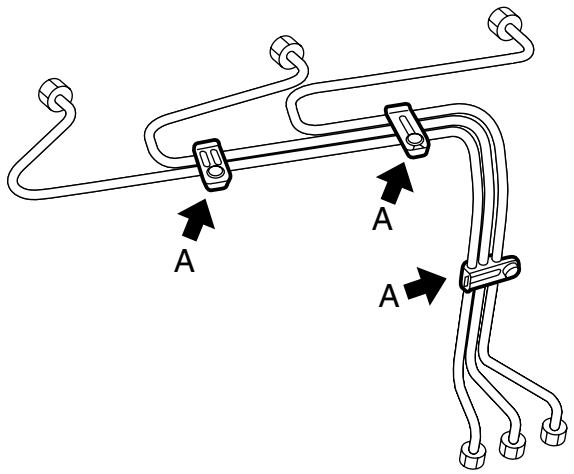
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, FUEL INJECTION PIPE

Removing the fuel injection pipe

Always leave the injection pipes fixed together as a complete set. Never remove or shift the clamping brackets (A) holding the pipes together. Never bend injector pipes as they may crack.

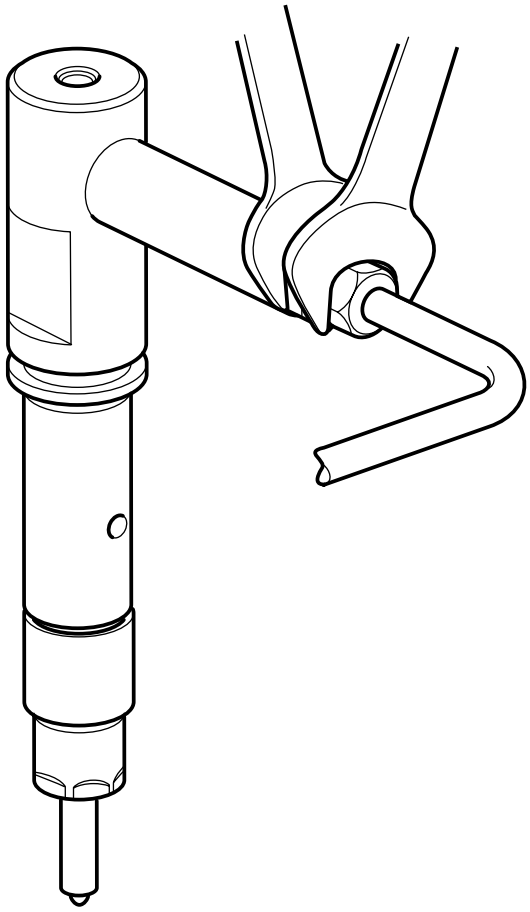
1. Disconnect the earth lead from the battery terminal.
2. Clean the union nuts and the area around both the injectors and the pump housing.



i 400199

When slackening the injection pipe union nuts, hold the injector's side connection back using an open-end spanner. If this is not done, there is a good chance that the side connection will leak. Immediately plug the openings.

3. Remove the fuel injection pipes as a set.



i 400237

Installing the fuel injection pipe

1. Blow the injector pipes with dry compressed air.
   Then turn the injector side towards the injectors.

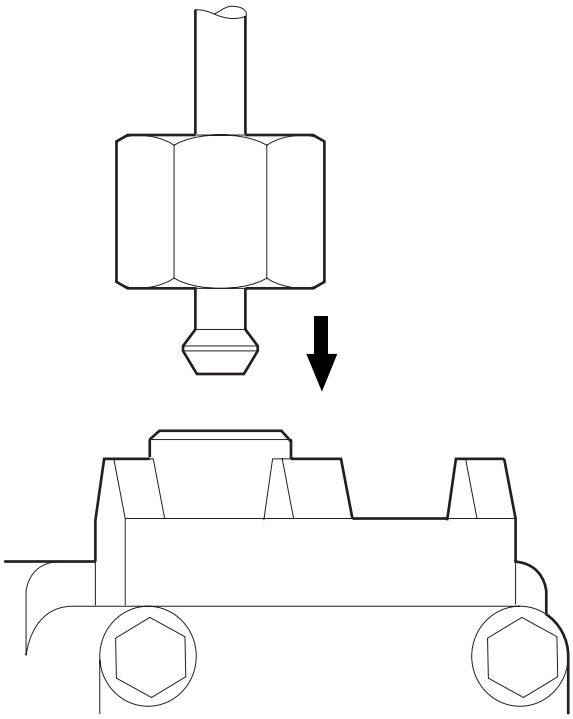
2. Position the set of injector pipes with the head on the connection of the pump unit (see diagram).

3. Tighten the union nuts to the pump connection by hand in the order 1-2-3 or 4-5-6.

4. Then tighten the union nuts on the injector side by hand in the order 1-2-3 or 4-5-6.

5. Then tighten the union nuts on the pump side in the order 1-2-3-4-5-6. Tighten them to the specified torque. See "Technical data".

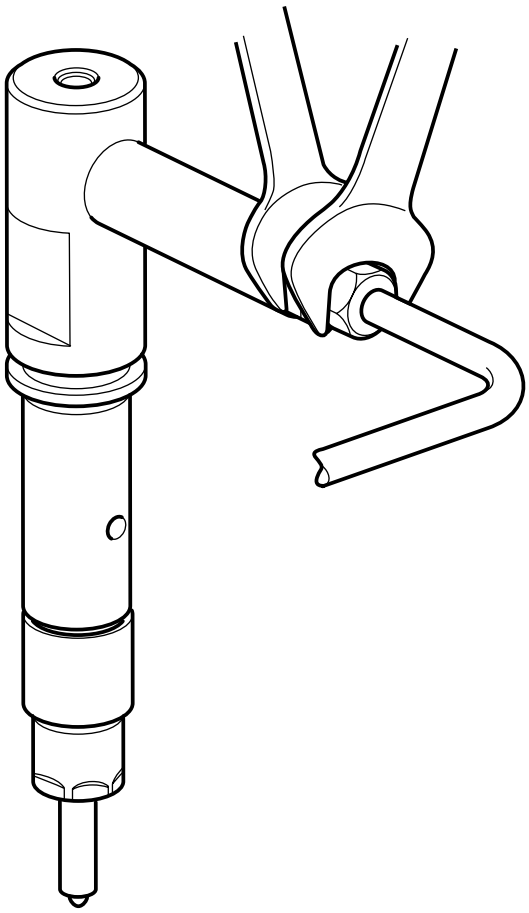
6. Now tighten the union nuts on the injector side in the order 1-2-3-4-5-6.



i400506

When tightening the injector pipe union nuts, hold the injector's side connection back using an open-end spanner. If this is not done, there is a good chance that the side connection will leak.

7. Tighten the injector pipe union nuts to the specified tightening torque. See "Technical data".



i 400237

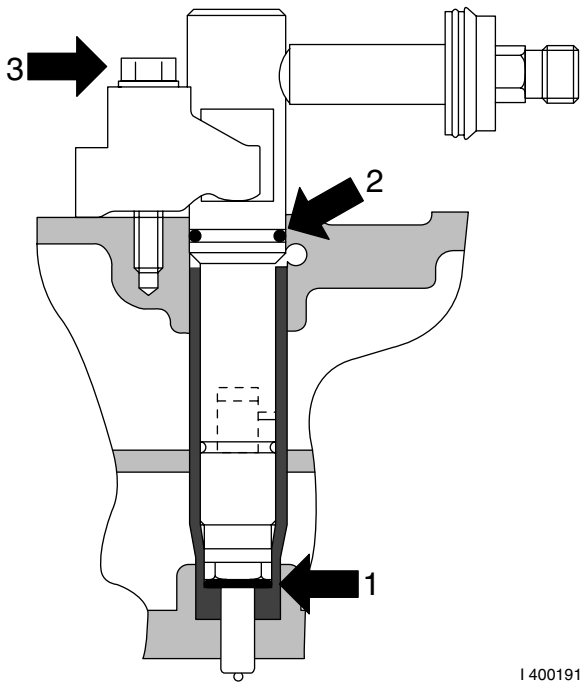
4.2 REMOVAL AND INSTALLATION, INJECTOR

Due to the presence of overpressure in the fuel tank, fuel may run into the cylinders when removing injectors. Therefore, when removing injectors, always first remove the tank cap. Collect any fuel from the injectors.

Removing the injector

1. Disconnect the earth lead from the battery terminal.
2. Remove the injector pipes as a set.
3. Remove the valve cover.
4. Remove the DEB.
5. Remove the attachment bolt (3) from the injector clamp. To remove the injector and the clamping piece, **only** use the special tools (DAF no. 1329412) and (DAF no. 0694928).

   Note:
   If during removal one or more copper shims (1) remain in the injector sleeve, the injector will be reinstalled in a higher position.
   As a result, instead of spraying into the combustion chamber of the piston, the fuel will be sprayed onto the piston ring. This may seriously damage the piston.
   There will be inadequate sealing between the O-ring (2) of the injector and the cylinder head. Fuel leaking from the injector can flow freely into the engine and dilute the lubricating oil.

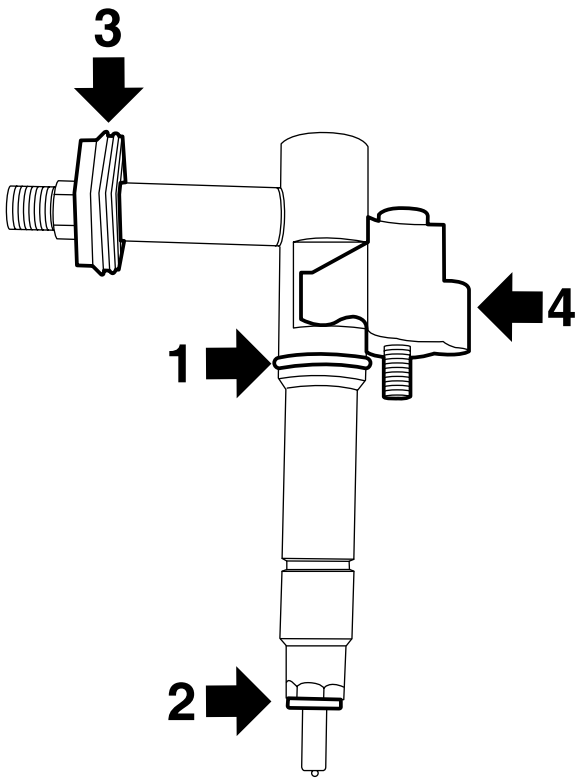


I 400191

Installing the injector

1. Clean the injector sleeve. See "Cleaning".
2. Fit a new O-ring (1) and a new copper shim (2) to the injector. Apply a little acid-free grease to both rings.
3. Inspect the valve sleeve seal (3) of the injector. Replace it if it is leaking and/or damaged.

   Note:
   Make sure that the injector clamp is installed correctly.
4. Fit the injector together with the injector clamp (4) and tighten the attachment bolt to the specified torque. See "Technical data".
5. Fit the DEB.
6. Adjust the DEB clearance.



i 400183

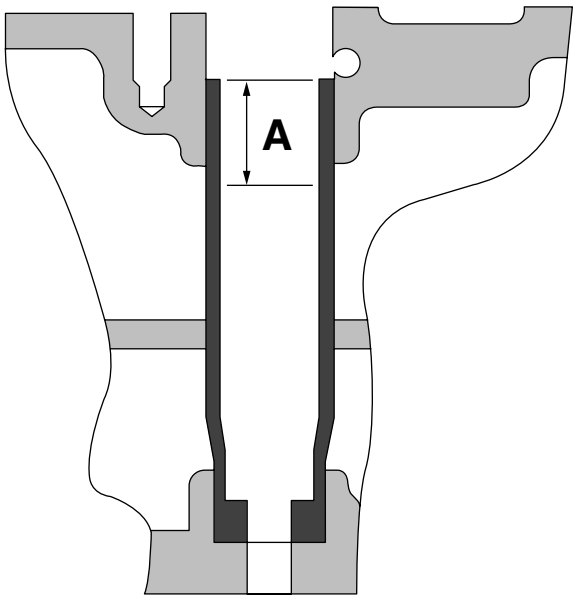
4.3 REMOVAL AND INSTALLATION, INJECTOR SLEEVE

Removing the injector sleeve

1. Partially drain the coolant.

2. Remove the injector.
   Insert a ball of crumpled paper into the injector sleeve to prevent metal particles from entering the engine.

3. Tap a thread (M22 x 1.5) over a length (A) of approx. 20 mm in the injector sleeve that is to be removed.
   Turn the special tool (DAF no. 1310425) into the injector sleeve and, using the special tool (DAF no. 0694928), remove the injector sleeve.



I 400195

Installing the injector sleeve

1. Clean the injector sleeve opening thoroughly.

   Note:
   Fit the **dry** injector sleeve in the cylinder head.
   Use the special tool (DAF no. 1329305) to tap the injector sleeve into the cylinder head.

2. Fit the injector.

3. Top up the cooling system.

4. Start the engine and check the engine for leaks.

4.4 REMOVAL AND INSTALLATION, PUMP UNIT

When removing the pump unit, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

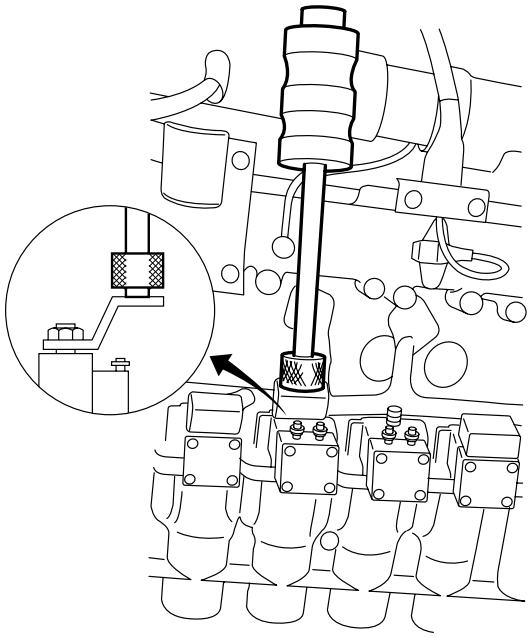
Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the pump unit

1. Disconnect the earth lead from the battery terminal.
2. Remove the electrical connections from the pump unit.
3. Remove the fuel pipes from the pump housing.
4. Remove the pressure relief valve from the pump housing.
5. Let the fuel leak from the pump housing.
6. Remove the injector pipes in sets and plug the pump units and injectors so that no dirt can enter.
7. If it is necessary to replace the pump unit(s), the pump unit must be marked so that it can be replaced in the same position in the pump housing.

   Note:
   The pump unit may be under spring tension, depending on the position of the camshaft in the pump housing.
8. Remove the attachment bolts from the pump unit.

9. Remove the pump unit. If necessary use the special tools (DAF no. 0694928) and (DAF no. 1329448).



i 400396

Installing the pump unit

Note:
Damage to the sealing ring could result in the lubricating oil being diluted.

1. Fit new sealing rings to the pump unit. Sealing ring 1 has the largest diameter and sealing ring 3 the smallest.

2. Apply a thin layer of lubricating oil to the bores in the pump housing for the sealing rings.

3. Crank the engine until the camshaft in the pump housing is in such a position that the pump unit can be fitted in the pump housing practically tension free.

4. Apply a thin layer of lubricant to the new sealing rings and fit the pump unit, without damaging the sealing rings, in the pump housing.

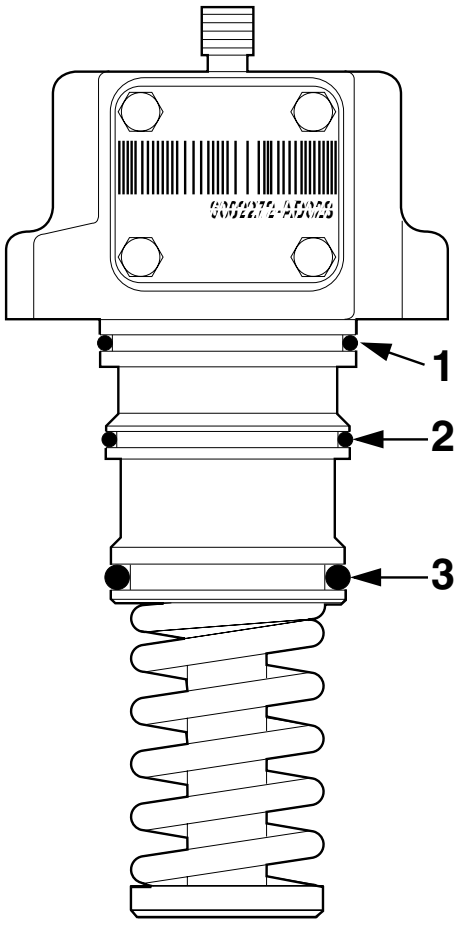
5. Fit the pump unit attachment bolts and tighten them evenly until the pump unit abuts the pump housing.

6. Tighten the attachment bolts to the specified torque. See "Technical data".

7. Fit the pressure relief valve onto the pump housing.

8. Fit the fuel pipes to the pump housing.

9. Fit the injector pipes.



i 400221

10. Fit the electrical connections to the pump unit.

11. Bleed the fuel system. See "Inspection and adjustment".

4.5 REMOVAL AND INSTALLATION, FUEL LIFT PUMP

When removing the fuel lift pump, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the fuel lift pump

1. Disconnect the earth lead from the battery terminal.

2. Remove the fuel pipes from the fuel lift pump.

3. Remove the attachment bolts from the fuel lift pump.

4. Remove the fuel lift pump.

Installing the fuel lift pump

1. Check the sealing ring of the fuel lift pump for damage. If required, replace the sealing ring.

2. Apply lubricating oil sparingly to the fuel lift pump sealing ring.

3. Fit the fuel lift pump.

4. Screw in the attachment bolts evenly and tighten them to the specified torque. See "Technical data".

5. Connect the fuel pipes.

6. Bleed the fuel system. See "Inspection and adjustment".

4.6 REMOVAL AND INSTALLATION, PUMP HOUSING

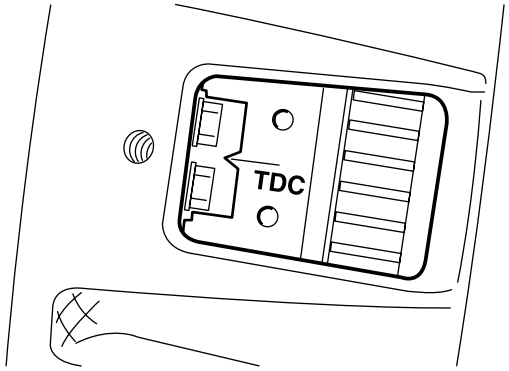
When removing the pump housing, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the pump housing

1. Crank the engine until the valves of cylinder 6 are in overlap position and the TDC mark on the flywheel is in the correct position.

2. Remove the timing cover.



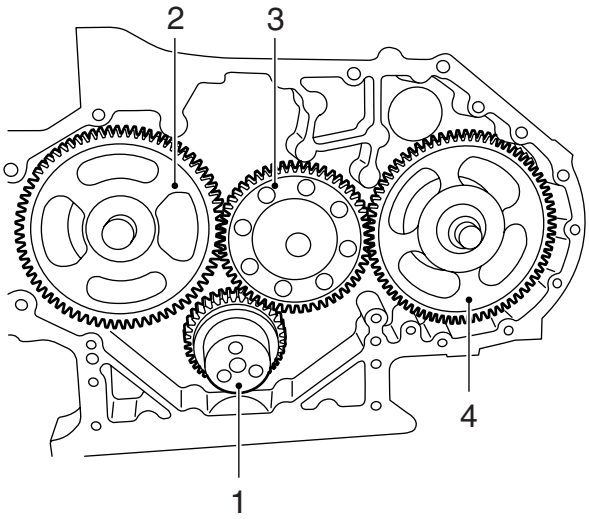
M201185

3. Remove the attachment bolt of the idler gear (3) and pump housing camshaft gear (4).

   Note:
   When the crankshaft (1) or the camshaft (2) without idler gear (3) is rotated separately, the engine's pistons may touch the valves.

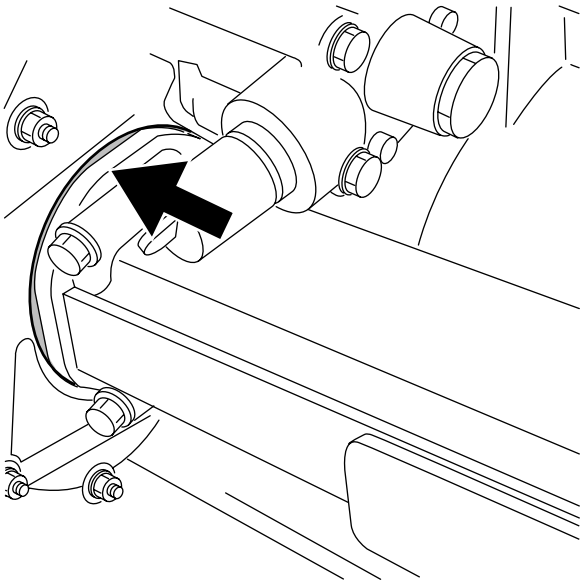
4. Remove the idler gear (3).

5. Remove the pump housing camshaft gear (4).



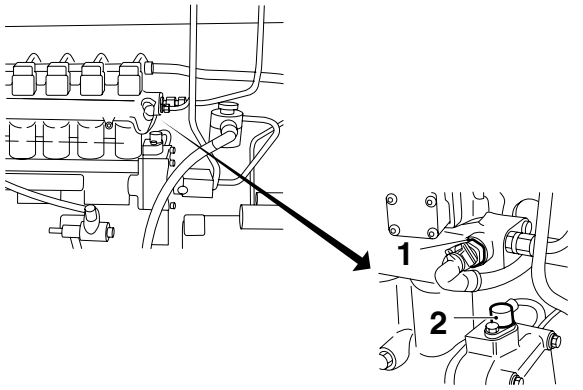
M200725

6. Remove the timing gear seal by tapping it out of the timing gear case in the driving direction.
7. Remove the electrical connections from the pump units.
8. Remove the fuel pipes from the pump housing.
9. Remove the pressure relief valve from the pump housing.
10. Let the fuel leak from the pump housing.
11. Remove the fuel pipes from the fuel lift pump.
12. Remove the fuel injection pipes and plug the pump units and injectors so that no dirt can enter the system.



M200728

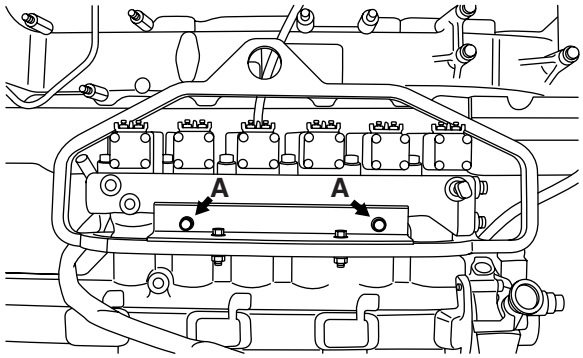
13. Remove the connector from the fuel temperature sensor (1) (if fitted on the pump housing).
14. Remove the camshaft position sensor (2).



i 400529

Due to the weight of the pump housing, use the special tool.

15. Fit the lifting gear (DAF no. 1329499) to the pump housing and tighten the bolts (A).
16. Remove the attachment bolts of the pump housing and lift the pump housing off the dowel pins on the engine block using the lifting gear.



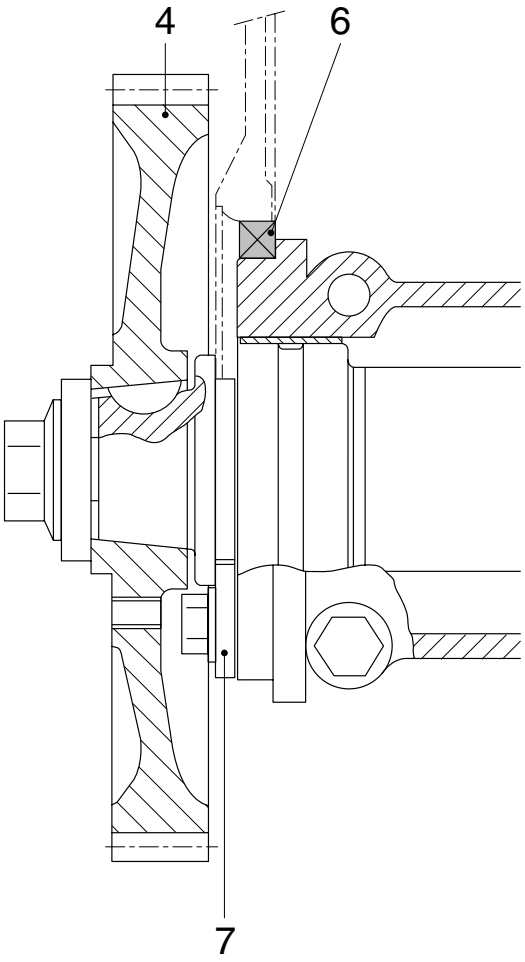
i400601

Installing the pump housing

1. Fit two new lubricating oil connection sealing rings.
2. Fit the pump housing using the lifting gear (DAF no. 1329499). Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the camshaft position sensor.
4. Fit the fuel temperature sensor connector.
5. Fit the electrical connections onto the pump units.
6. Fit the injection pipes.
7. Connect the fuel pipes of the fuel lift pump.
8. Fit the pressure relief valve onto the pump housing.
9. Fit the fuel pipes to the pump housing.

10. Fit a dry new timing case seal (6) using the special tool (DAF no. 1329318).

11. Check whether cylinder 1 is at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).



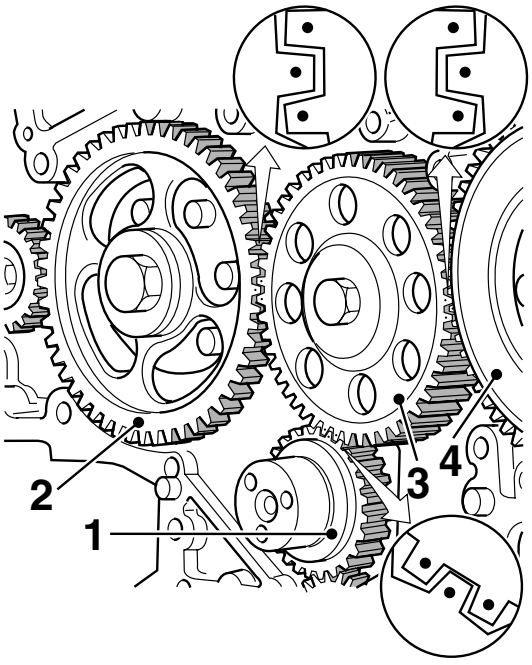
M200841

12. Fit the pump housing camshaft gear (4) in such a position that the idler gear (3) can be installed in accordance with the marks.

13. Fit the attachment bolts of the pump housing camshaft gear (4) and idler gear (3) and tighten to the specified torque. See "Technical data".

14. Fit the timing cover.

15. Bleed the fuel system. See "Inspection and adjustment".



M201281

4.7 REMOVAL AND INSTALLATION, FUEL PIPES

Removal, fuel pipes

1. Disconnect the earth lead from the battery terminal.

2. Disconnect the appropriate fuel pipe and collect the escaping fuel.

3. If the pipe is damaged in any way, it should be replaced.

Leaks from fuel pipes must be remedied as soon as possible to reduce fire risk.

Installation, fuel pipes

1. Always use new copper sealing rings during fitting.

2. Tighten union nuts and banjo bolts to the specified torque. See "Technical data".

Note:
In the event of a leakage from a pipe coupling, do not overtighten the union nut. First check whether the leak is at the connection point between the pipe and coupling or at the connection point between coupling and the component housing.

If the leakage has not stopped after the union nut has been tightened, it will be necessary to take the coupling apart.
Check the parts for deposits and/or damage.

Pipes may chafe if they touch each other or other parts of the vehicle.

Pipes showing evidence of wear must be replaced without delay.

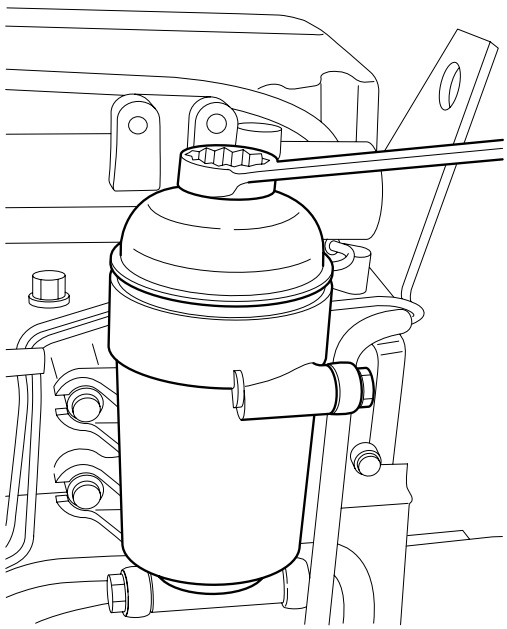
4.8 REMOVAL AND INSTALLATION, FUEL FILTER ELEMENT

When removing the fuel filter, a quantity of fuel will escape. Collect the fuel to avoid the risk of fire.

Removing the fuel filter element

1. Remove the cover together with the fuel filter element from the filter housing.

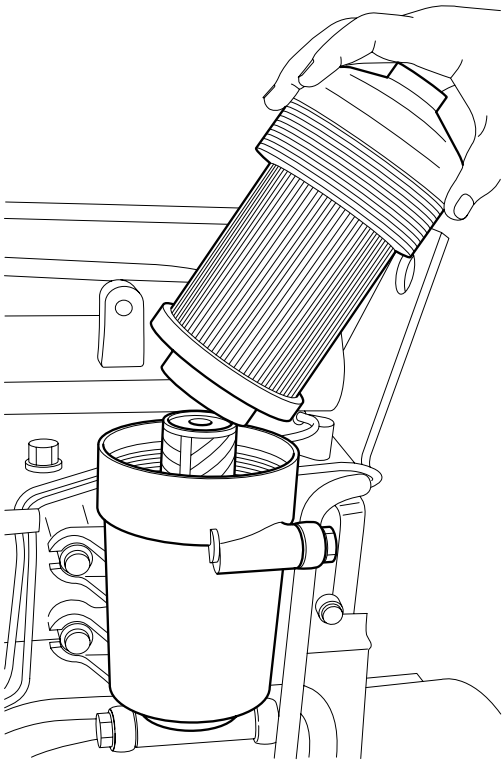
   Note:
   The fuel filter element is a disposable filter, and may not be cleaned and reused. Dispose of the filter as chemical waste.



i 400444

Fitting the fuel filter element

1. Replace the cover O-ring.
2. Fit the fuel filter element in the cover
3. Fit the cover with fuel filter element. Tighten the filter cover to the specified torque. See "Technical data".
4. Pump for approximately 1 minute using the primer pump to partially fill the filter housing with fuel.
5. Start the engine and run it at idling speed for a few minutes; this will allow any air in the filter housing to escape.
6. If the motor will not start up or runs very erratically, the fuel system must be bled, see "Draining and filling".
7. Check the fuel system for leaks.



i 400445

4.9 REMOVAL AND INSTALLATION, FUEL LEVEL ELEMENT

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Removal, fuel level element

1. Disconnect the earth lead from the battery terminal.

   Note:
   To prevent dirt from entering, first clean the fuel tank.

2. Remove the connector from the fuel level element.

3. Remove the fuel pipes from the fuel level element.

4. Turn the fuel level element a quarter turn anti-clockwise.

5. Carefully remove the fuel level element from the fuel tank.

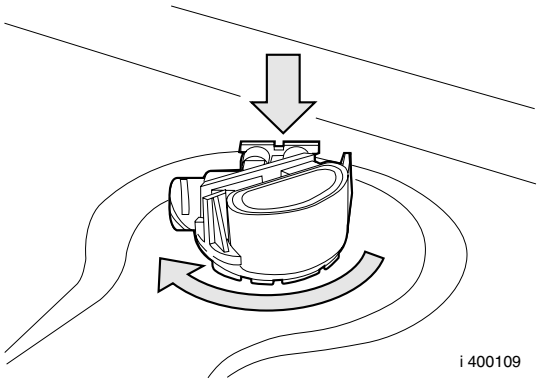
6. Replace the O-ring.

Installation, fuel level element

1. Check that the fuel pipes are fitted correctly in the tank filter.

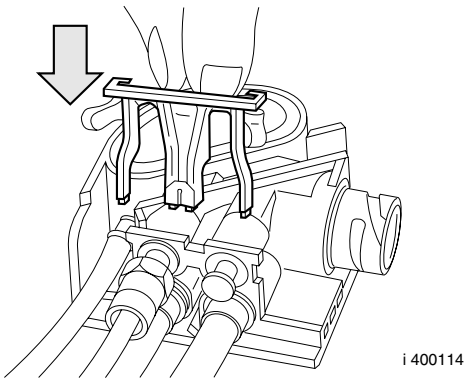
2. Fit the fuel level element carefully in the fuel tank.

3. Insert the fuel level element into the hole of the tank and turn it clockwise a quarter turn.



4. Insert the fuel pipes into the fuel level element.

5. Fit the connector of the fuel level element.


i 400114

4.10 REMOVAL AND INSTALLATION, FUEL TANK FILTER

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

5

Removing fuel tank filter

1. Remove the fuel level element.

2. Remove the fuel tank filter.

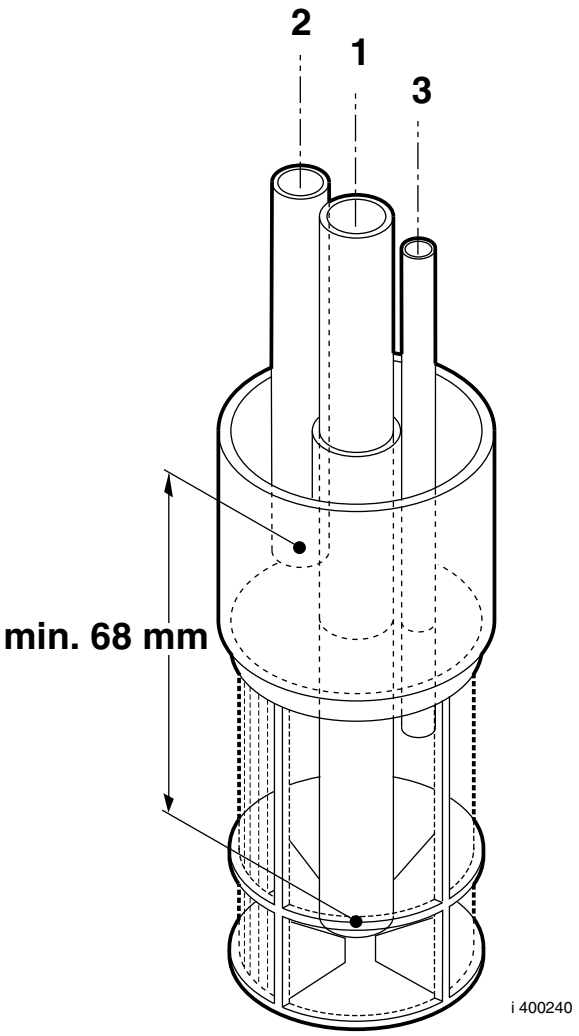
Fitting fuel tank filter

1. Check that the difference in length between the supply pipe (1) and return pipe (2) is at least 68 mm.

2. Slide the fuel tank filter as far as possible onto the supply pipe (1).

   Note:
   Make sure that when fitting the fuel tank filter the return pipe (2) is inserted into the fuel tank filter by-pass and that the cab heater supply pipe (3), if present, is inserted into the filter part.

3. Fit the fuel level element.



4.11 REMOVAL AND INSTALLATION, FUEL PREFILTER/WATER SEPARATOR FILTER ELEMENT

When removing the fuel prefilter/ water separator, a quantity of fuel will escape. Collect the fuel to avoid the risk of fire.

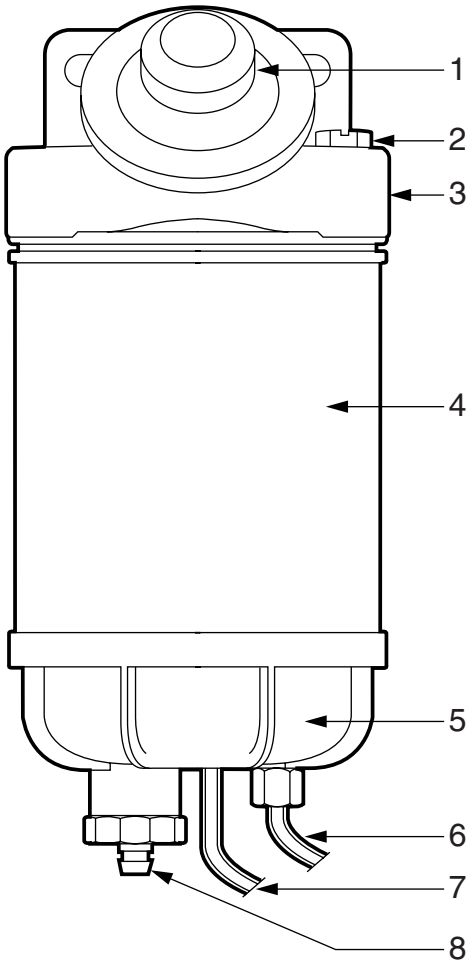
Version: Racor

Removing the fuel prefilter/water separator filter element

1. Drain the fuel from the filter element by unscrewing the bleed plug (2) and opening the drain plug (8).
2. If fitted, disconnect the water sensor (6) and the heating element (7) connectors.
3. Remove the filter element (4) and the bottom cover (5). Clean the O-ring seal.

Installing the fuel prefilter/water separator filter element

1. Apply a film of engine oil to the O-ring and the new sealing ring.
2. Fit the bottom cover (5) onto the new filter element (4).
3. Fit the bottom cover (5) together with the new filter element (4) to the filter housing (3).
4. Hand-tighten the new filter.
5. If fitted, attach the water sensor and heating element connectors.
6. Check whether the drain plug (8) is tight.
7. Open the air-bleeder plug (2) a couple of turns.
8. Operate the primer pump (1) until fuel comes out of the air-bleeder plug.
9. Close the air-bleeder plug (2).
10. Start the engine and check for leaks. If necessary, retighten the filter element (4) by hand.



i400356

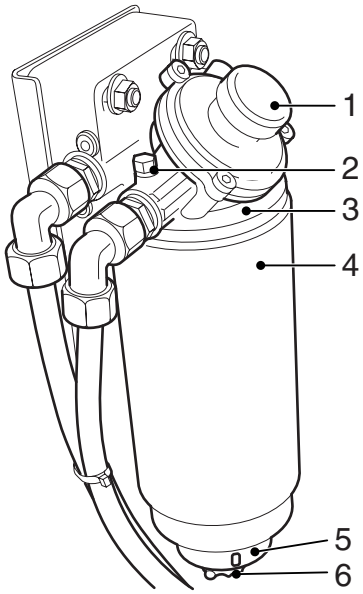
Version: Mann + Hummel

Removing the fuel prefilter/water separator filter element

1. Drain the fuel from the filter element by unscrewing the bleed plug (2) and opening the drain plug (6).
2. If fitted, unplug the connectors of the water sensor and the heating element.
3. Remove the filter element (4) together with the bottom cover (5) and clean the O-ring seal.

Installing the fuel prefilter/water separator filter element

1. Apply a film of engine oil to the O-ring and the new sealing ring.
2. Fit the bottom cover (5) onto the new filter element (4).
3. Fit the bottom cover (5) together with the new filter element (4) to the filter housing (3).
4. Hand-tighten the new filter.
5. If fitted, attach the water sensor and heating element connectors.
6. Check whether the drain plug (6) is tight.
7. Open the air-bleeder plug (2) a couple of turns.
8. Operate the primer pump (1) until fuel comes out of the air-bleeder plug.
9. Close the air-bleeder plug (2).
10. Start the engine and check for leaks. If necessary, retighten the filter element (4) by hand.



G0 00 266

5

5

© 200324

5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, PUMP HOUSING

When disassembling the pump housing, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the system can lead to significant damage to fuel system components.

Disassembling the pump housing

1. Remove the pump housing. See "Removal and installation".

   Note:
   If after removal the pump units are not replaced in the same position, they must be re-calibrated.

2. Remove the pump units. See "Removal and installation".

3. Remove the tappet rollers.

4. Remove the fuel lift pump. See "Removal and installation".

5. Remove the cover and check the O-ring. If necessary, replace the O-ring.

6. Remove the pulse disc from the pump camshaft.

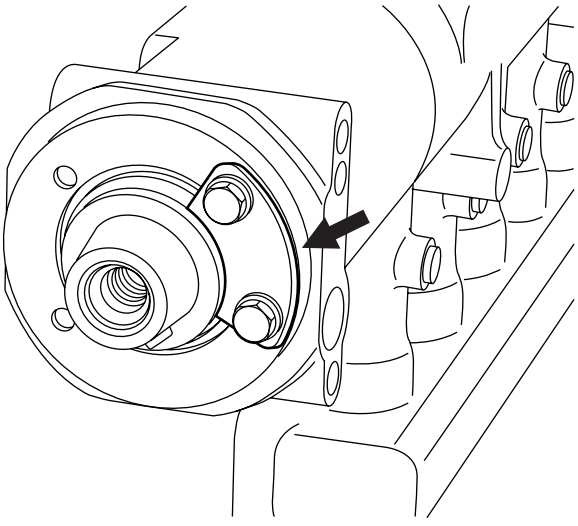
7. Remove the locking plate from the pump camshaft.

   Note:
   When removing the sealing plates, an amount of lubricating oil will escape. Collect this lubricating oil.

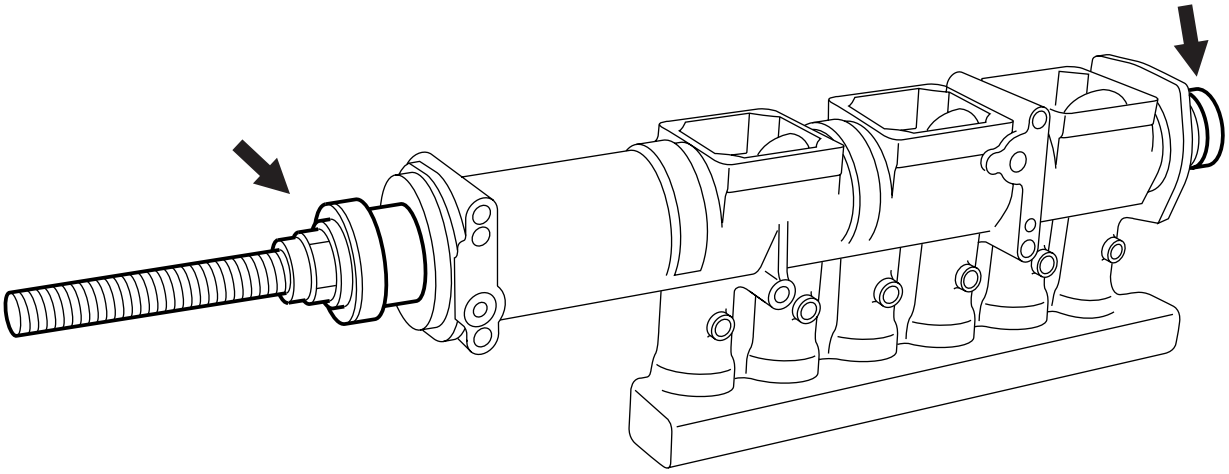
8. Remove the sealing plates and the gaskets.

9. Remove the pump camshaft by manoeuvring it vertically out of the pump housing.

10. Remove the slide bearings using the special tools (DAF no. 1329444) and (DAF no. 0535626).



i400380

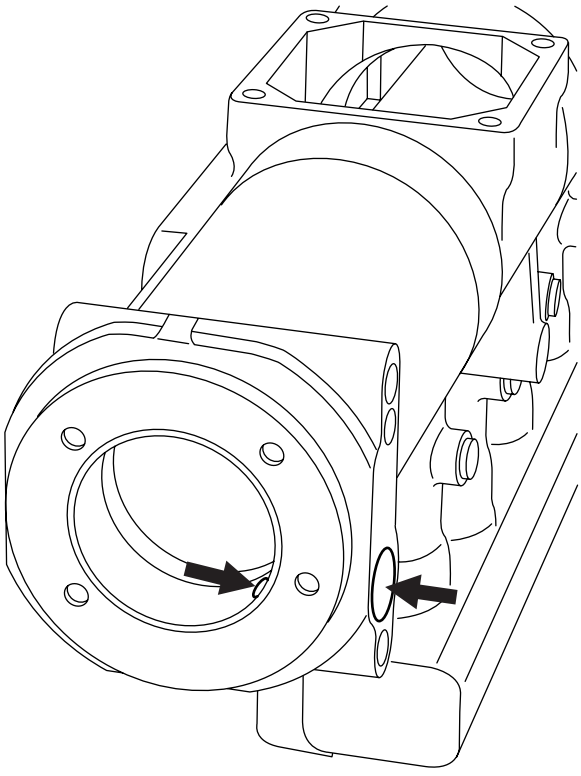


i400378

5

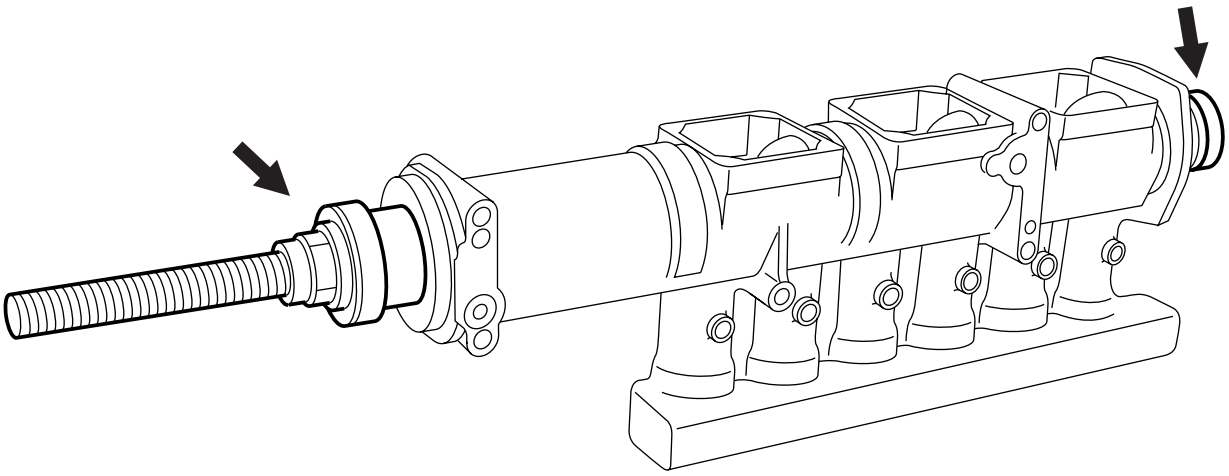
Assembling the pump housing

When fitting the front bearing shell it is important that the oil bore in the bearing housing aligns with the hole in the slide bearing.



i400382

© 200324



i400378

1. Use the special tools (DAF no. 1329444) and (DAF no. 0535626) to fit the bearing shells.

   Note:
   Before fitting the pump camshaft, oil the bearing journals lightly with lubricating oil. When fitting the bearing shells, take care not to damage them.

2. Fit the pump camshaft by lowering it vertically into the pump housing.

3. Clean the gaskets if necessary. Fit the gaskets and sealing plates and tighten the bolts to the specified torque. See "Technical data".

   Note:
   When fitting the locking plate, make sure it does not stick in the pump camshaft groove.

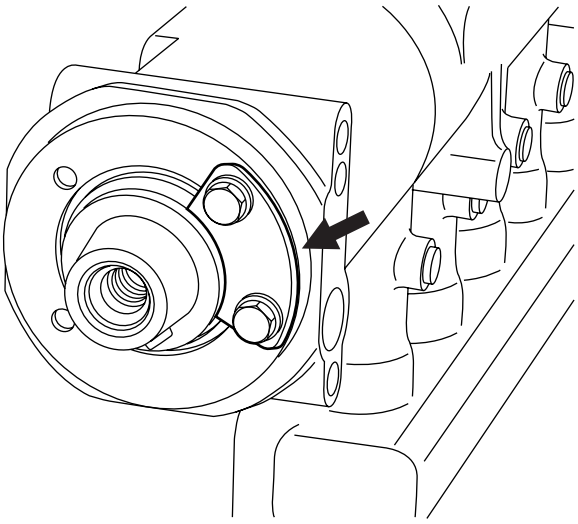
4. Fit the locking plate of the pump camshaft and the bolts, tightening them to the specified torque. See "Technical data".

5. Fit the pulse disc and tighten the bolts to the specified torque. See "Technical data".

6. If necessary, clean the groove in which the O-ring is fitted and apply a thin layer of lubricating oil.

7. Fit the O-ring.

8. Fit the cover and tighten the bolts to the specified torque. See "Technical data".
9. Fit the fuel lift pump. See "Removal and installation".
10. Apply a thin layer of lubricating oil to the tappet rollers.
11. Fit the tappet rollers.
12. Fit the pump units. See "Removal and installation".



i400380

© 200324

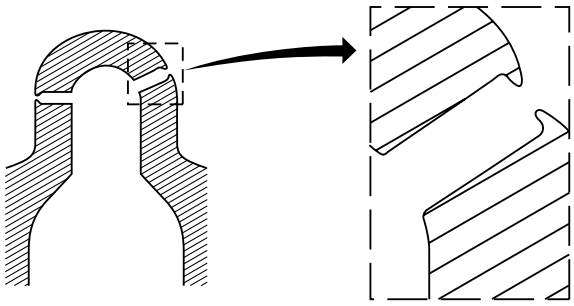
6. CLEANING

6.1 CLEANING, INJECTOR

The injector body (nozzle) must never be cleaned with copper or steel wire brush. When cleaning the exterior of the injector nozzle, do not pass the brush over the injector nozzles. If this happens, the nozzle must be replaced.

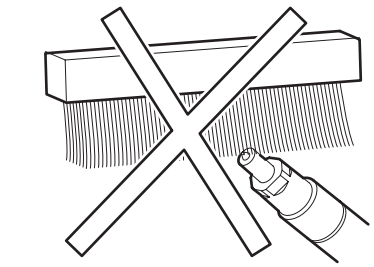
Injector nozzles
The use of steel or copper brushes can cause deformation of the injector nozzles with the result that the fuel is not injected in the corrrect way and the amount of fuel injected is affected.
Such deformation cannot be detected by carrying out the normal injector test.

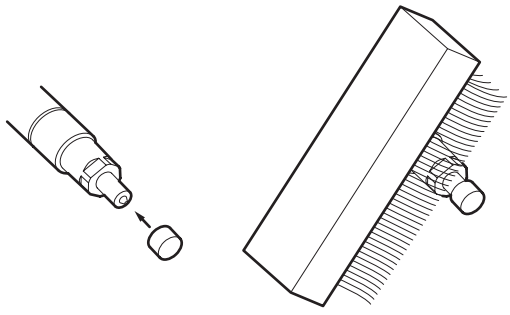
The injector nozzles must not be cleaned (with a needle).



M2 00 040

Nozzle
Before cleaning the nozzle, cover the injector nozzles and only clean the nozzle with the brass hand brush in the injector cleaning set (DAF no. 1329371).

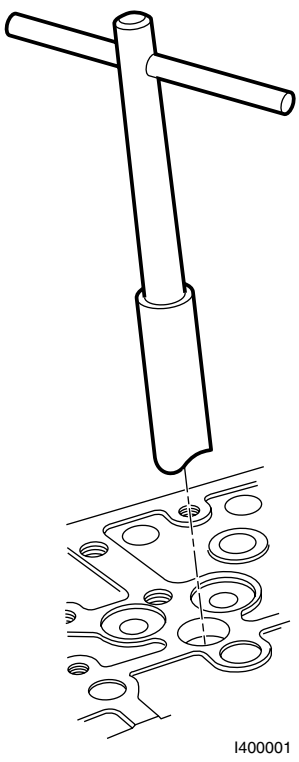




i 400413

6.2 CLEANING, INJECTOR SLEEVE

1. Remove the injector. See "Removal and installation".
2. Remove any copper washer left behind using the special tool (DAF no. 1240074).
3. Clean the injector sleeve using the special tool (DAF no. 1240074).
4. Clean the injector sleeve with compressed air.
5. Fit the injector. See "Removal and installation".


I400001

© 200324

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of components	2-1	200324
2.2	System description, turbocharger	2-3	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspecting and adjusting turbocharger wastegate	3-1	200324
3.2	Checking exhaust gas back pressure	3-2	200324
3.3	Inspection and pressure testing, air inlet system	3-3	200324
3.4	Checking inlet underpressure	3-4	200324
3.5	Checking the glow plug	3-4	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation, turbocharger	4-1	200324
4.2	Removal and installation of air cooler	4-3	200324
4.3	Removal and installation, air filter element	4-6	200324
5.	**CLEANING**	5-1	200324
5.1	Cleaning the exterior of radiator/air cooler	5-1	200324
5.2	Cleaning, air filter element	5-2	200324

6

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

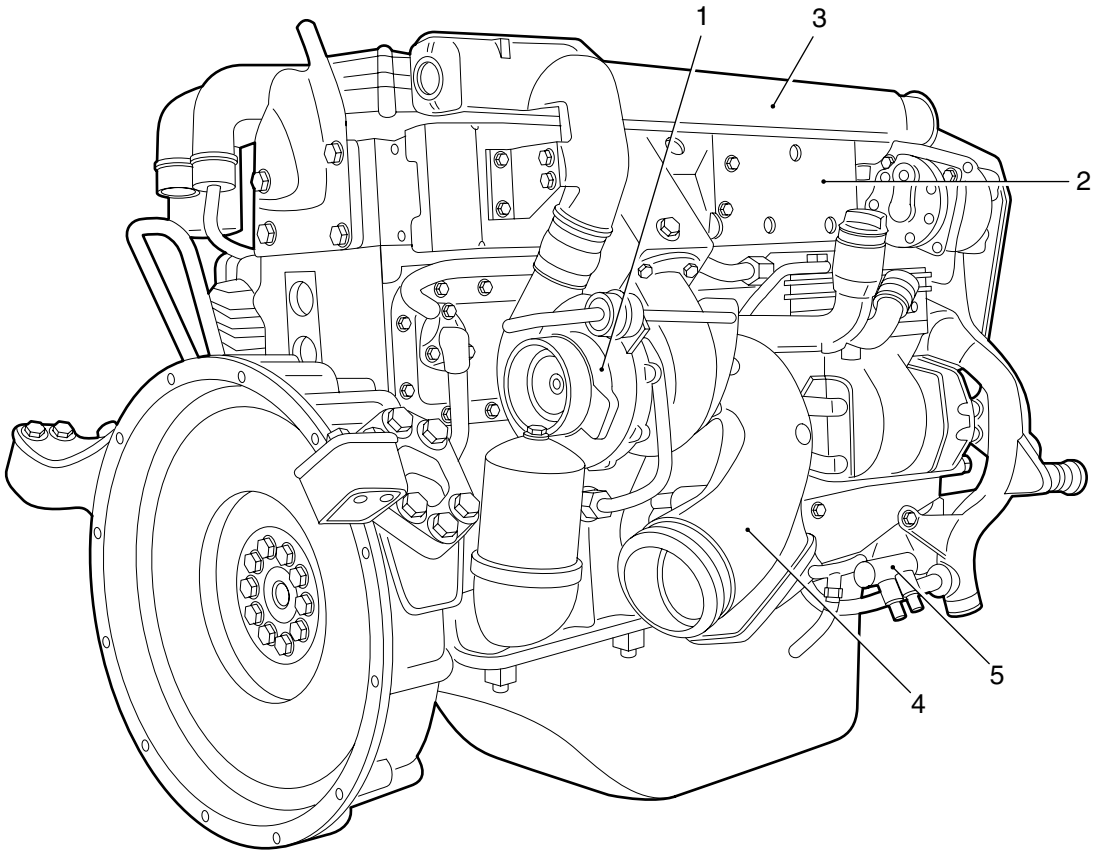
© 200324

6

© 200324

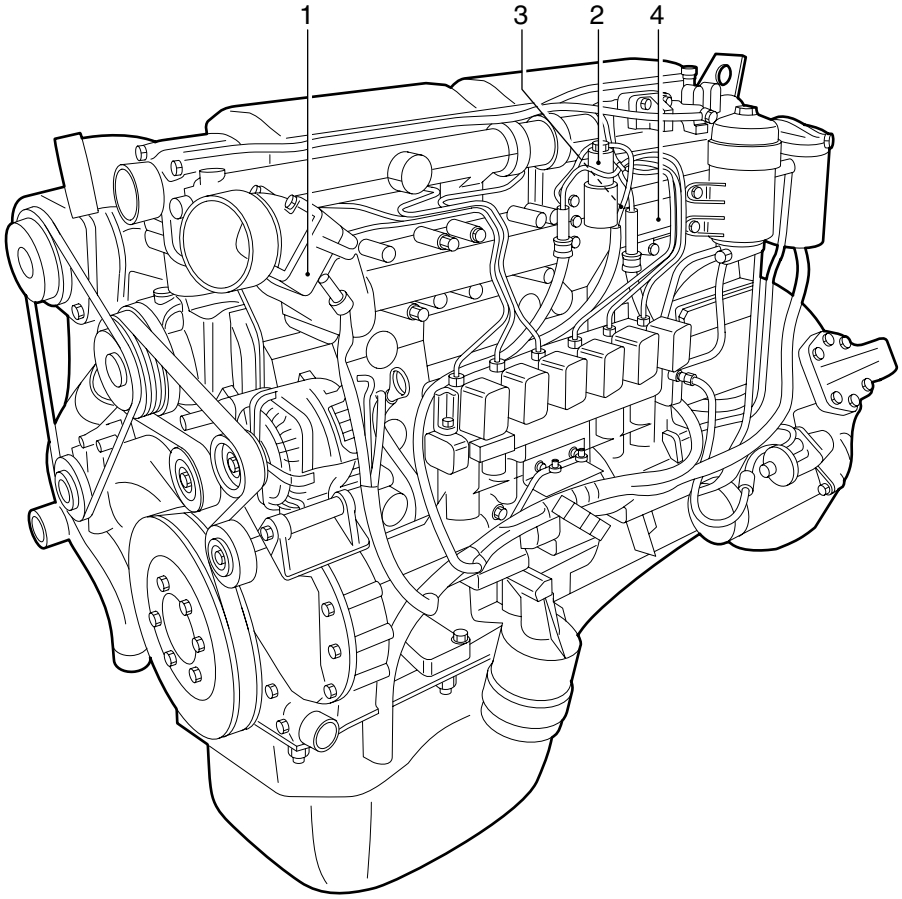
2. GENERAL

2.1 LOCATION OF COMPONENTS



M201160

1. Turbocharger
2. Exhaust manifold
3. Air intake pipe
4. Exhaust elbow with integrated butterfly valve
5. Exhaust brake valve



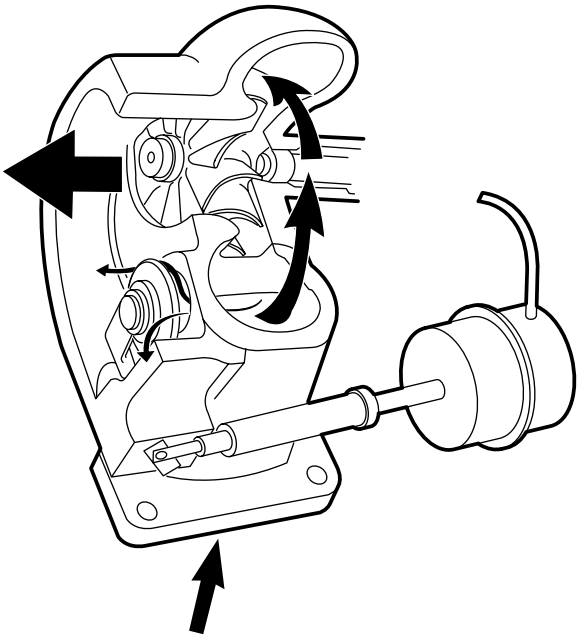
M201186

1. Glow plug
2. Glow plug relay
3. Boost pressure sensor
4. Inlet manifold

© 200324

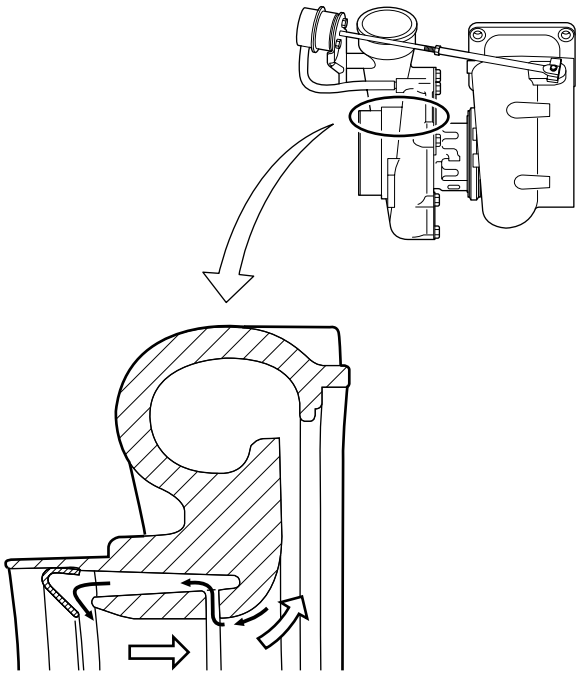
2.2 SYSTEM DESCRIPTION, TURBOCHARGER

Wastegate
To make the engine more responsive at lower engine speeds, a turbocharger is used that produces a better charge ratio at these speeds. Without provision having been made for this, the boost pressure yielded by this turbocharger would be too high at maximum engine speeds. Use of a wastegate prevents this.
The turbocharger's compressor housing has an air coupling connected to a diaphragm. The boost pressure yielded by the turbocharger operates the diaphragm and the control rod connected to it. The control rod operates a valve in the turbine housing.
The valve in the turbine housing is opened when the maximum pre-set pressure has been reached.
When the valve is opened, some of the exhaust gases will be discharged directly to the exhaust pipe rather than being used to propel the turbocharger's turbine wheel.



i400309

Compression housing by-pass
At higher boost pressures, the turbocharger compressor tends to allow this pressure to return to the intake underpressure area. To prevent this, the turbocharger's compression housing has been adapted.
This adaptation consists of bypass ducts and a stop plate.
Boost pressure attempting to return to the intake area will do so at the outer circumference of the compression housing.
The compression housing has been fitted with an air slot to force this pressure to flow back through special air ducts on the outside until it is arrested by the stop plate.



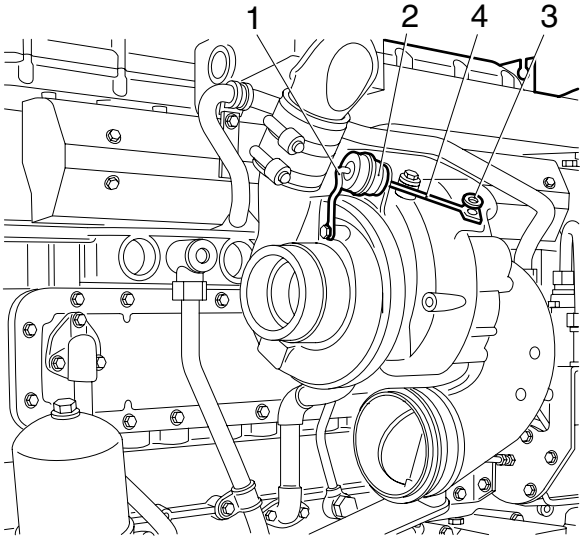
i 400212

© 200324

3. INSPECTION AND ADJUSTMENT

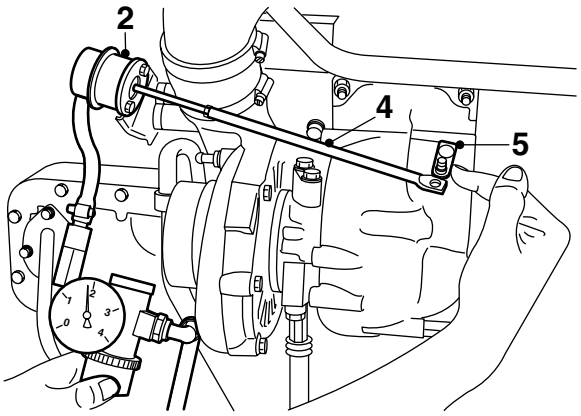
3.1 INSPECTING AND ADJUSTING TURBOCHARGER WASTEGATE

1. Remove the heat shield from the turbocharger.
2. Remove the air supply connector (1) from the diaphragm housing (2).
3. Remove the retaining clip (3) and remove the control rod (4) from the wastegate lever.



I400532

4. Using a reducer valve, apply the specified adjusting pressure to the connection with the diaphragm housing (see "Technical data").
5. Push the wastegate lever (5) fully to the left to close the wastegate valve.
6. Adjust the length of the control rod (4), making sure it fits exactly onto the lever at the set pressure.
7. Inspect the adjustment of the wastegate using the specified pressure. See "Technical data".
8. Fit the retaining clip (3).



i 400214

3.2 CHECKING EXHAUST GAS BACK PRESSURE

Checking exhaust gas back pressure

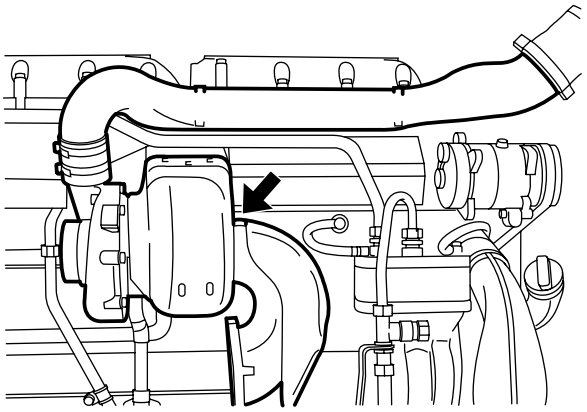
1. Remove the plug from the exhaust bracket and install a suitable coupling with a pipe. The first part of the pipe must be made of metal, to withstand the high temperatures.

2. Connect a pressure gauge to the pipe, with a range of at least 0.1 - 0.2 bar (10 - 20 kPa).

   Note:
   Use an attenuated gauge to prevent excessive shaking of the gauge needle.

   The engine brake must not be used during measurements.
   This is to protect the pressure gauge.

3. Measure the exhaust gas back pressure at full-load engine speed and compare the measurement to the specified value; see "Technical data".



i 400180

6

3.3 INSPECTION AND PRESSURE TESTING, AIR INLET SYSTEM

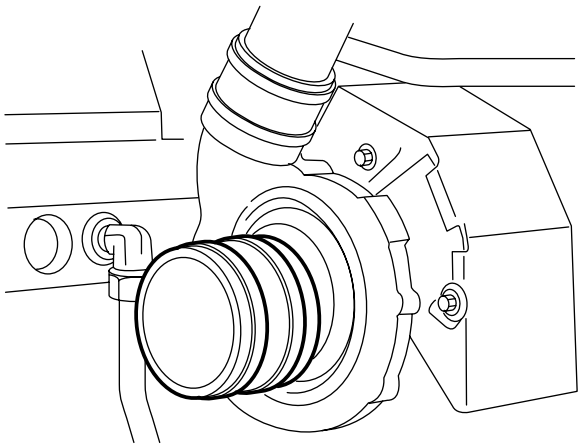
When pressure testing the air intake system, the plugs may spring off if they are not properly secured.

Check the condition and mounting of the air inlet channels/pipes of the air intake system.

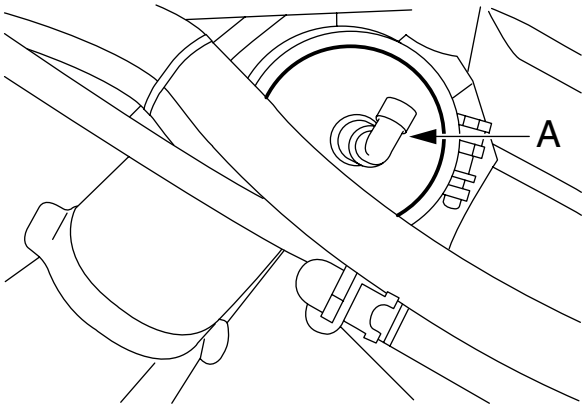
In case of doubt as to the proper sealing of the air intake system, which is indicated by the following:
1. loss of power
2. high fuel consumption
3. unusual sounds,

carry out a pressure test to check the air inlet system for leaks.

1. Remove the pipe between the air filter housing and the intake port on the suction side of the turbocharger.
2. Fit the special tools (DAF no. 1329320) and (DAF no. 1329403) to the suction side of the intake port and plug the opening.
3. Remove the air inlet hose between the air cooler and the inlet manifold.
4. Fit the special tool (DAF no. 0694831) onto the air cooler.
5. Connect a flexible air pipe with reducer valve to the coupling (A) and charge the system to approx. 1 bar.
6. Use a soapy solution to check the whole inlet system for air leaks. Also check whether the pressure gauge of the reducer valve drops.



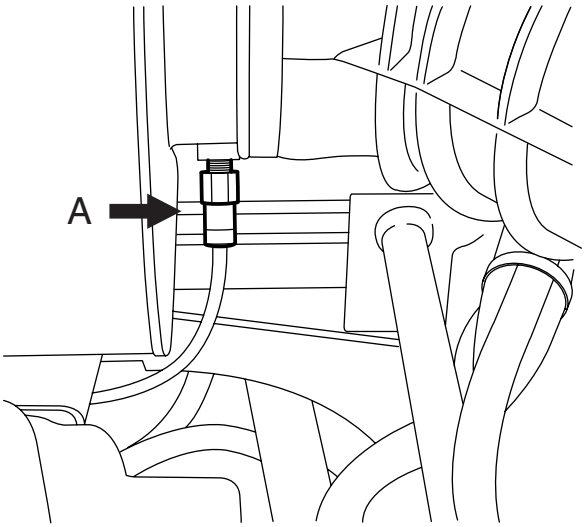
i 400376



i400325

3.4 CHECKING INLET UNDERPRESSURE

1. Remove the underpressure indicator connection (A) from the air intake pipe between the air filter housing and turbocharger.
2. Connect a pressure gauge with a maximum rating of -100 mbar (-10 kPa) to the connection of the underpressure indicator.
3. Measure the inlet underpressure at full-load engine speed and compare the measurement to the specified value. See "Technical data".



i400377

3.5 CHECKING THE GLOW PLUG

Checking the glow plug

1. Remove the electrical connections on the glow plug.
2. Using a multimeter, determine the resistance of the glow plug. See "Technical data".
3. Remove the connecting hose between the inlet pipe and the air cooler.
4. Check whether the glow plug is damaged.

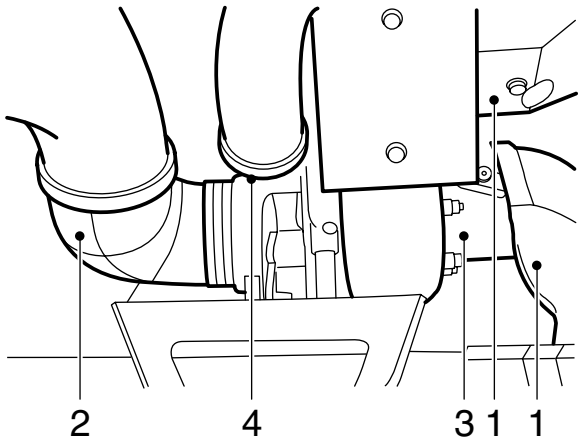
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, TURBOCHARGER

If the turbocharger to be replaced has been damaged to such an extent that parts of the turbocharger are missing, or lubricating oil has entered the inlet system, the inlet and exhaust systems must be checked and cleaned thoroughly in order to prevent serious damage to the engine.

Removing the turbocharger

1. Remove the heat shields (1) from the turbocharger.
2. Remove the air inlet hose (2) between the turbocharger and air filter.
3. Remove the exhaust brake (3).
4. Disconnect the connector pipe (4) from the turbocharger and the air intake pipe to the air cooler.
5. Remove the turbocharger lubricating oil pipes. Plug the openings.
6. Remove the attachment nuts from the turbocharger.
7. Remove the turbocharger from the exhaust manifold.



i400344

Installing the turbocharger

1. Before installing the turbocharger, check the following:
   - turbocharger shaft must run smoothly
   - turbocharger shaft must not be out of true
   - turbocharger shaft must have a little radial clearance.

   If applicable:
   - movement of the wastegate.
2. Clean the sealing surfaces.
3. Apply a layer of Copaslip to the exhaust manifold studs.
4. Always use new gaskets during installation.
5. Fit the turbocharger. If necessary, turn the two halves of the housing so that the oil and air pipes can be connected free of stress.
6. Fit the oil discharge pipe.

© 200324

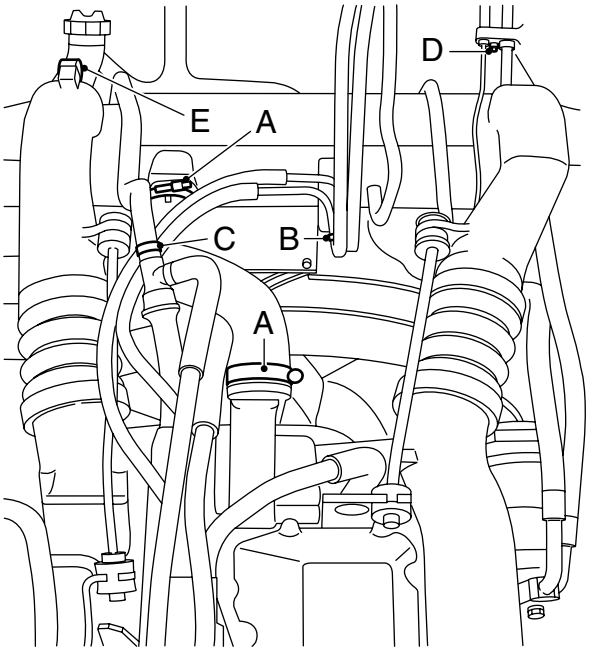
7. Spray clean engine oil into the oil supply of the turbocharger and fit the oil supply pipe.
8. Fit the connector pipe from the turbocharger and the air intake pipe to the air cooler.
9. Fit the exhaust brake.
10. Fit the air inlet hose between the turbocharger and the air filter.
11. Fit the heat shields for the turbocharger.

4.2 REMOVAL AND INSTALLATION OF AIR COOLER

Note:
The removal and installation procedure of the air cooler allows for the presence of an air-conditioning unit.
If such a unit is not present, the sections concerned can be skipped. Draining and filling of the air-conditioning system must only take place if the workshop is certified to do this.

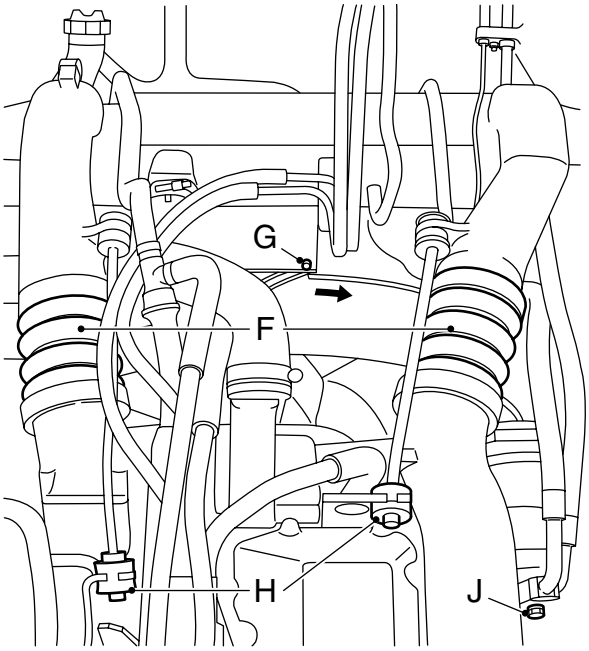
Removing the air cooler

1. Disconnect the earth lead from the battery terminal.
2. Drain the engine coolant from the radiator.
3. Disconnect the pipe from the bottom of the radiator.
4. Carefully disconnect the air-conditioning compressor and condenser and hang them to one side (the system must not be opened).
5. Disconnect the oil filler pipe and hang it to one side.
6. Disconnect all coolant hoses (A, B and C) connected to the radiator.



M201031

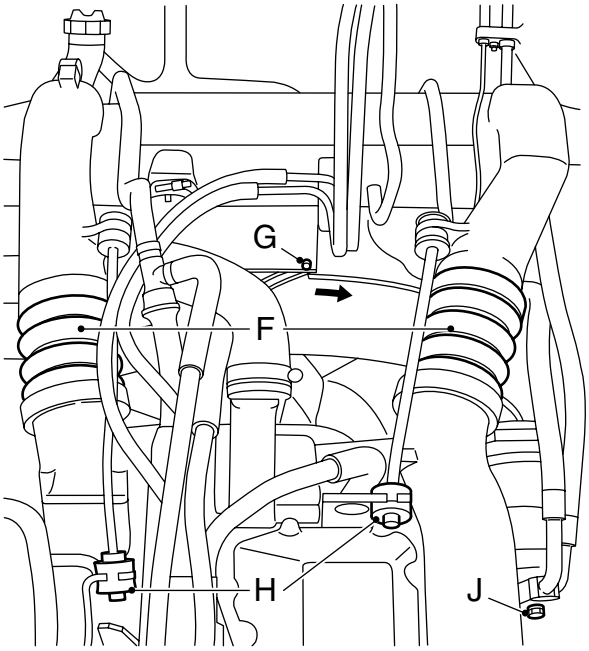
7. Remove the left push/pull rod (H).
8. Remove the rubber air inlet hoses (F).
9. Remove the retaining screw (G) and turn the wind tunnel collar into the wind tunnel.
10. Remove the attachment nuts on the bottom of the radiator and remove the assembly.



M201032

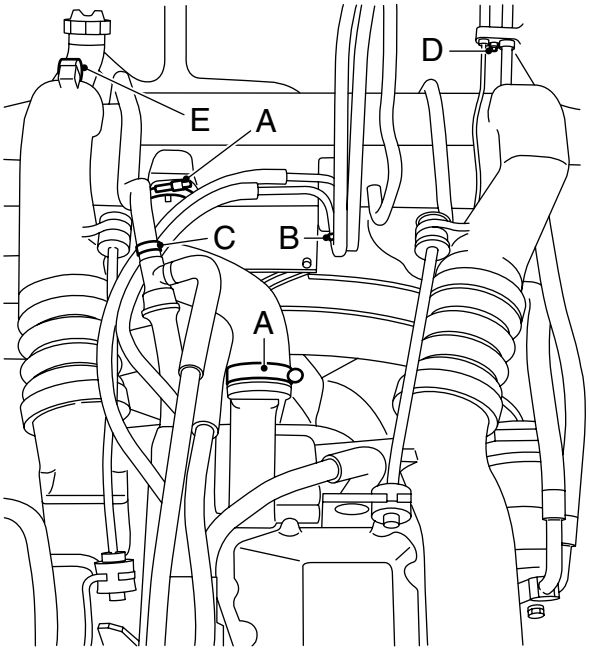
Installing the air cooler

1. Position the radiator assembly, carefully lower it into the chassis and fasten the radiator.
2. Turn the wind tunnel collar back and position the retaining screw (G).
3. Fit the rubber air inlet hoses (F).
4. Fit the push/pull rods (H).



M201032

5. Fit the coolant hoses (A, B and C).
6. Tighten the oil filler pipe.
7. Fit the air conditioning unit.
8. Fasten the pipe on the bottom of the radiator.
9. Fill the cooling system. See "Draining and filling".
10. Start the engine and check for water leaks.

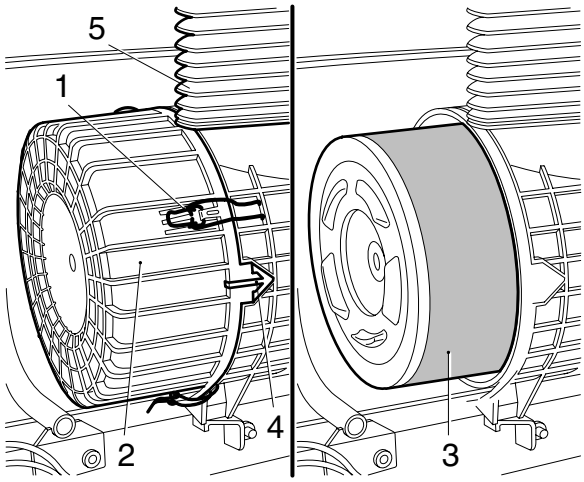


M201031

4.3 REMOVAL AND INSTALLATION, AIR FILTER ELEMENT

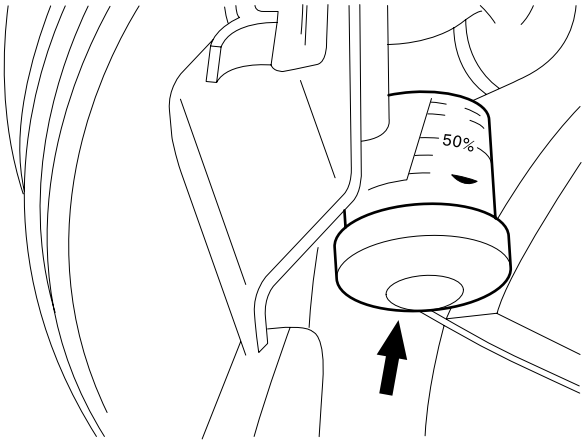
Removing the air filter element

1. Loosen the brackets (1) of the air filter cover (2).
2. Remove the air filter cover (2).
3. Remove the air filter element (3).
4. Clean the inside of the air filter housing and the air filter cover.



i400443

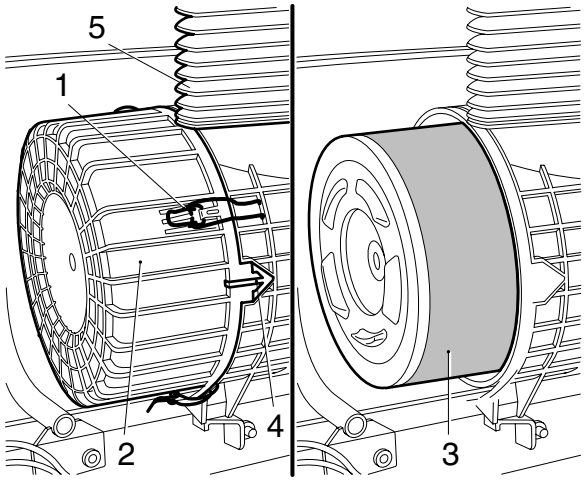
5. When replacing the air filter element, reset the air filter indicator, if fitted, by pressing the button on the top of the indicator.



V300386

Installing the air filter element

1. Fit the air filter element (3) to the air filter housing.
2. Fit the air filter cover. Note the position of the arrow (4) on the air filter cover (2)
3. Fit the clamp brackets (1) around the air filter.
4. Check that the flexible sealing bellows (5) on the air intake is not damaged. Replace if necessary.



i400443

5. CLEANING

5.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER

Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

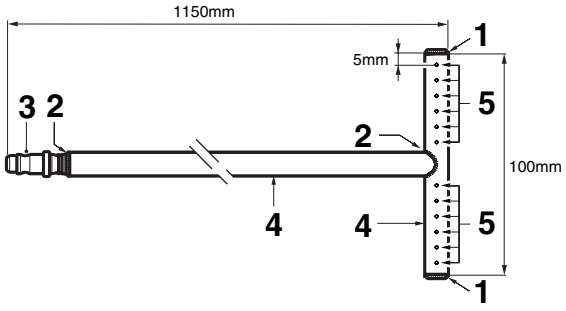
1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.
This tool can be made in your own workshop. It cannot be ordered from DAF.

Key to drawing:

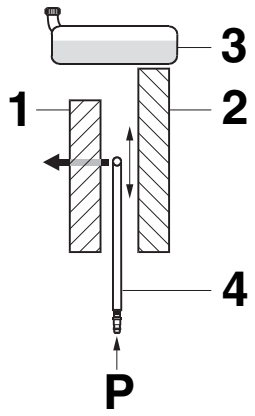
1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, ø 10 mm
5. 6 x ø 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side.



M2108

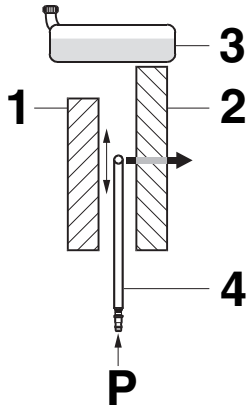
Note:
Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

1. From below, insert the radiator cleaner (4) between the air cooler (1) and radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.



M2109

3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).
4. Fit the wire mesh.
5. Install the lower grille.

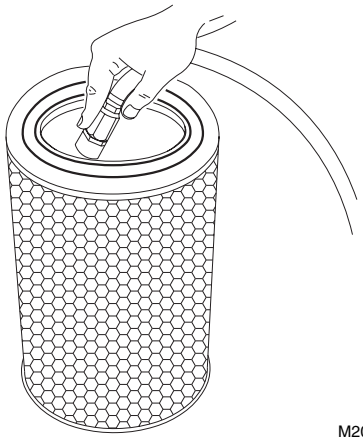


M2110

5.2 CLEANING, AIR FILTER ELEMENT

Inhalation of dust may have serious consequences for your health. Use mouth and eye protection.

1. Remove the air filter element. See "Removal and installation".
2. Check the air filter element for damage. If the air filter element or its sealing rings are damaged, the air filter element must be replaced.
3. Knock out the air filter element.
4. Blow-clean the air filter element by blowing pressurised air through from the inside, using a maximum pressure of approx. 1.5 bar.
5. Fit the air filter element. See "Removal and installation".


M2009

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of exhaust brake components	2-1	200324
2.2	System description, exhaust brake	2-2	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspection and adjustment, exhaust brake	3-1	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation of exhaust brake	4-1	200324

7

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

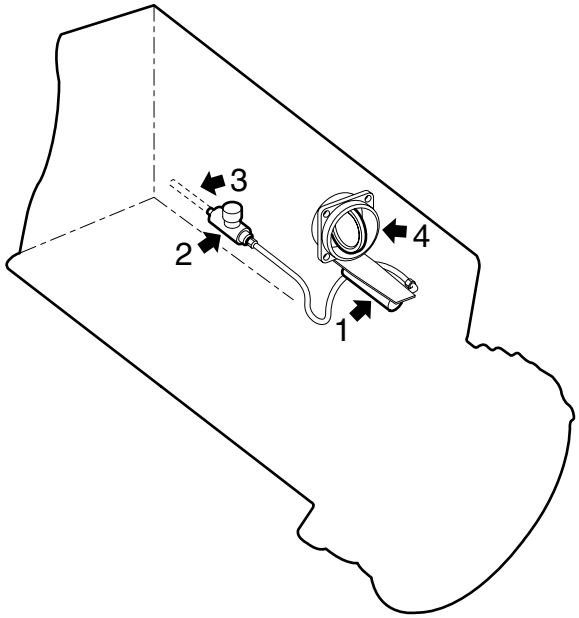
7

© 200324

2. GENERAL

2.1 LOCATION OF EXHAUST BRAKE COMPONENTS

1. Operating cylinder, exhaust brake
2. Exhaust brake valve
3. Supply pressure
4. Butterfly valve

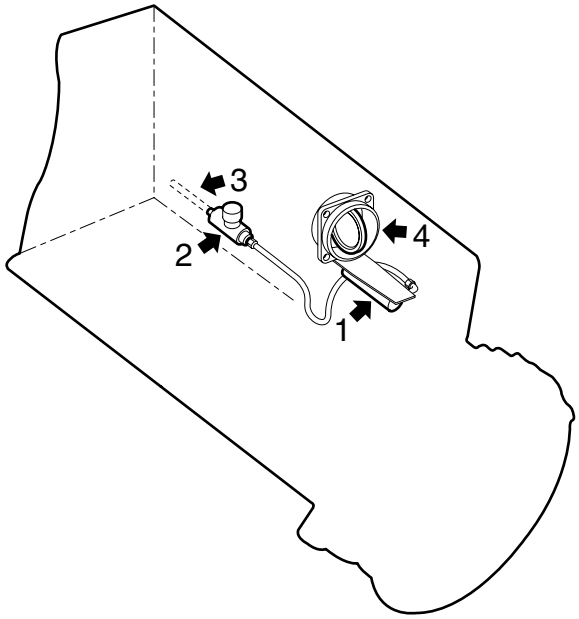


I400533

7

2.2 SYSTEM DESCRIPTION, EXHAUST BRAKE

1. Butterfly valve operating cylinder
2. Exhaust brake valve
3. Supply pressure
4. Butterfly valve



I400533

Switching on the exhaust brake
The exhaust brake consists of an engine brake operating switch fitted in the cab floor and an operating cylinder (2) connected to the butterfly valve in the exhaust pipe.
If the engine brake control switch is operated, a signal is passed to the engine management system's electronic unit. The engine management system's electronic unit interrupts the fuel supply to the various cylinders. The unit also energises the exhaust brake valve, causing compressed air to flow to the operating cylinder (2). The cylinder closes the butterfly valve in the butterfly valve housing. The exhaust pipe is then almost completely closed off.
Controlled discharge of exhaust gases is still possible through a calibrated hole in the butterfly valve.
The engine now acts as a compressor, creating a braking action.
The higher the engine speed, the greater the braking action of the exhaust brake.

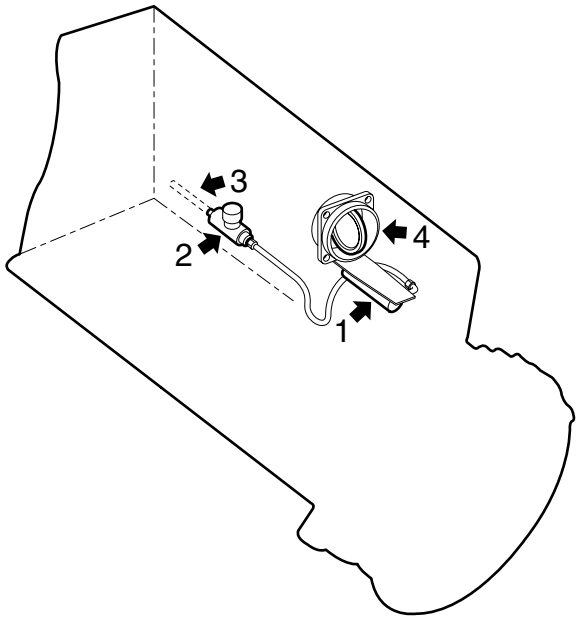
Switching off the exhaust brake
If the engine brake control switch is released, the fuel supply to the various cylinders will be re-instated and the butterfly valve will be re-opened.

3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION AND ADJUSTMENT, EXHAUST BRAKE

Checking exhaust brake

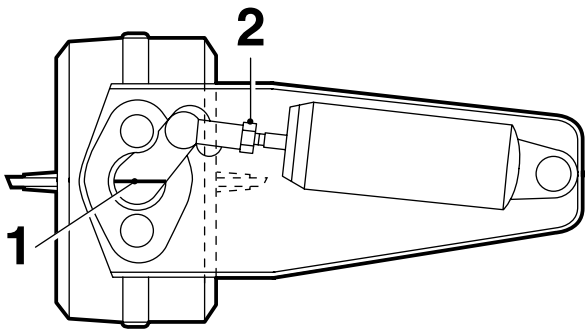
1. Use air pressure to check the exhaust brake (4) for smooth operation.
   This can be done by electrically activating the exhaust brake valve (2) or by pressurising the exhaust brake cylinder (1) yourself.



I400533

Setting the exhaust brake

1. Release the ball head of the butterfly valve control lever.
2. Open the butterfly valve fully (exhaust brake inactive), indicated by the mark (1) on the butterfly valve shaft.
3. Set the length of the piston rod (2), making sure that without air pressure a pre-load of 1 to 2 mm is present.



I400186

7

© 200324

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION OF EXHAUST BRAKE

Removing the exhaust brake

1. Disconnect the air supply connection from the operating cylinder.
2. Remove the heat shield from the exhaust elbow.
3. Remove the 6 attachment nuts holding the exhaust elbow to the turbocharger.
4. Remove the clamping strip with which the exhaust elbow is attached to the exhaust.
5. Remove the exhaust elbow including the butterfly valve.

Installation, exhaust brake

1. Check the butterfly valve for smooth operation.
2. Check the sealing faces of the exhaust elbow and the exhaust pipe.
3. Clean the turbocharger stud bolts and apply heat-resistant grease to the threads.
4. Fit the exhaust elbow and butterfly valve.
5. Evenly tighten the attachment nuts to the specified torque.
6. Fit the clamping strip.
7. Check the setting of the exhaust brake; see "Inspection and adjustment".

7

© 200324

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of components	2-1	200324
2.2	System description, UPEC fuel system	2-2	200324
2.3	Description of components	2-7	200324
2.4	Cranking the engine	2-13	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspecting fuel level element	3-1	200324
3.2	Inspecting injector opening pressure	3-3	200324
3.3	Inspecting injector operation	3-5	200324
3.4	Inspecting fuel system for leakage	3-6	200324
3.5	Bleeding the fuel system	3-8	200324
3.6	Inspection, gallery pressure	3-10	200324
3.7	Checking the fuel prefilter/water separator	3-11	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation, fuel injection pipe	4-1	200324
4.2	Removal and installation, injector	4-3	200324
4.3	Removal and installation, injector sleeve	4-5	200324
4.4	Removal and installation, pump unit	4-6	200324
4.5	Removal and installation, fuel lift pump	4-9	200324
4.6	Removal and installation, pump housing	4-10	200324
4.7	Removal and installation, fuel pipes	4-14	200324
4.8	Removal and installation, fuel filter element	4-15	200324
4.9	Removal and installation, fuel level element	4-16	200324
4.10	Removal and installation, fuel tank filter	4-18	200324
4.11	Removal and installation, fuel prefilter/water separator filter element	4-19	200324
5.	**DISASSEMBLY AND ASSEMBLY**	5-1	200324
5.1	Disassembly and assembly, pump housing	5-1	200324
6.	**CLEANING**	6-1	200324
6.1	Cleaning, injector	6-1	200324
6.2	Cleaning, injector sleeve	6-2	200324

8

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

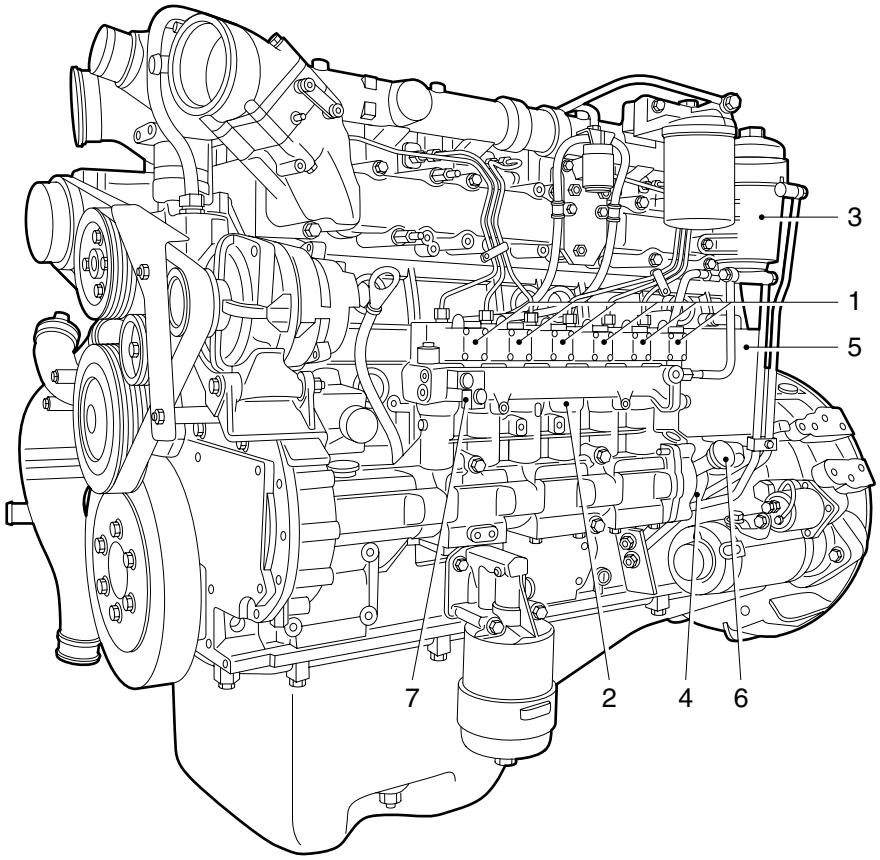
Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

8

© 200324

2. GENERAL

2.1 LOCATION OF COMPONENTS

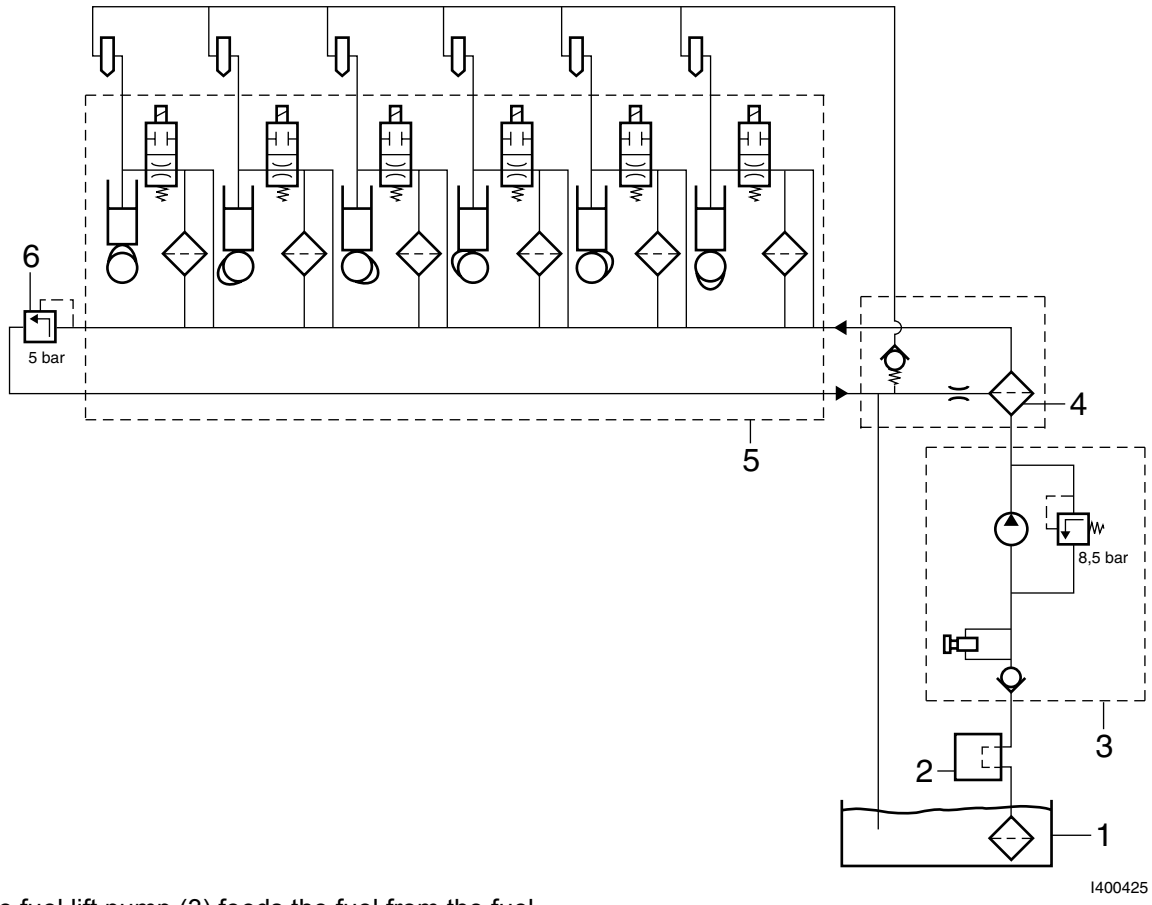


i4 00 683

1. Pump units
2. Pump housing
3. Fuel fine filter
4. Fuel lift pump
5. UPEC electronic unit
6. Primer pump
7. Pressure relief valve

8

2.2 SYSTEM DESCRIPTION, UPEC FUEL SYSTEM



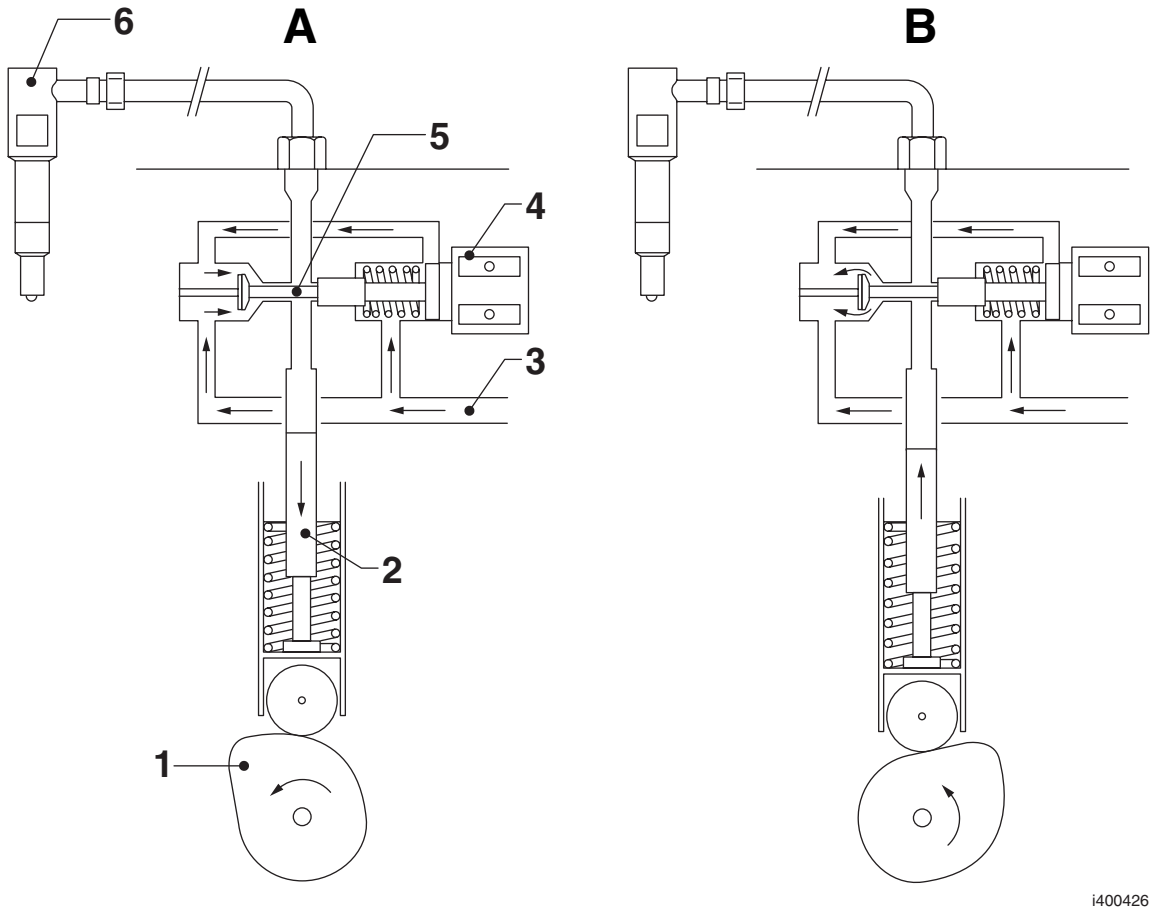
The fuel lift pump (3) feeds the fuel from the fuel tank (1) through the cooling plate (2).
The purpose of the cooling plate (2) is to ensure that the electronic unit does not become too hot.
The fuel lift pump (3) is fitted opposite the pump housing (5) and is driven by the camshaft in the pump housing.
From the fuel lift pump, fuel is forced towards the fuel fine filter (4).
For the purpose of constant bleeding, there is a calibrated bore in the fuel fine filter.
After the filter, the fuel enters the pump housing (5).
The pump units driven by the electronic unit are fitted in the pump housing (5).
The pump units force the fuel at high pressure (approx. 1600 bar) to the injectors.

At the end of the supply channel, there is a pressure relief valve (6) that connects the supply and discharge channels at a specific supply channel pressure. The pressure relief valve ensures a good degree of filling for the pump units. The discharge channel is connected to the fuel tank (1) return pipe via the fuel fine filter.

The injector leak-off pipe is connected to the return pipe to the fuel tank (1) via a non-return valve in the fuel fine filter.

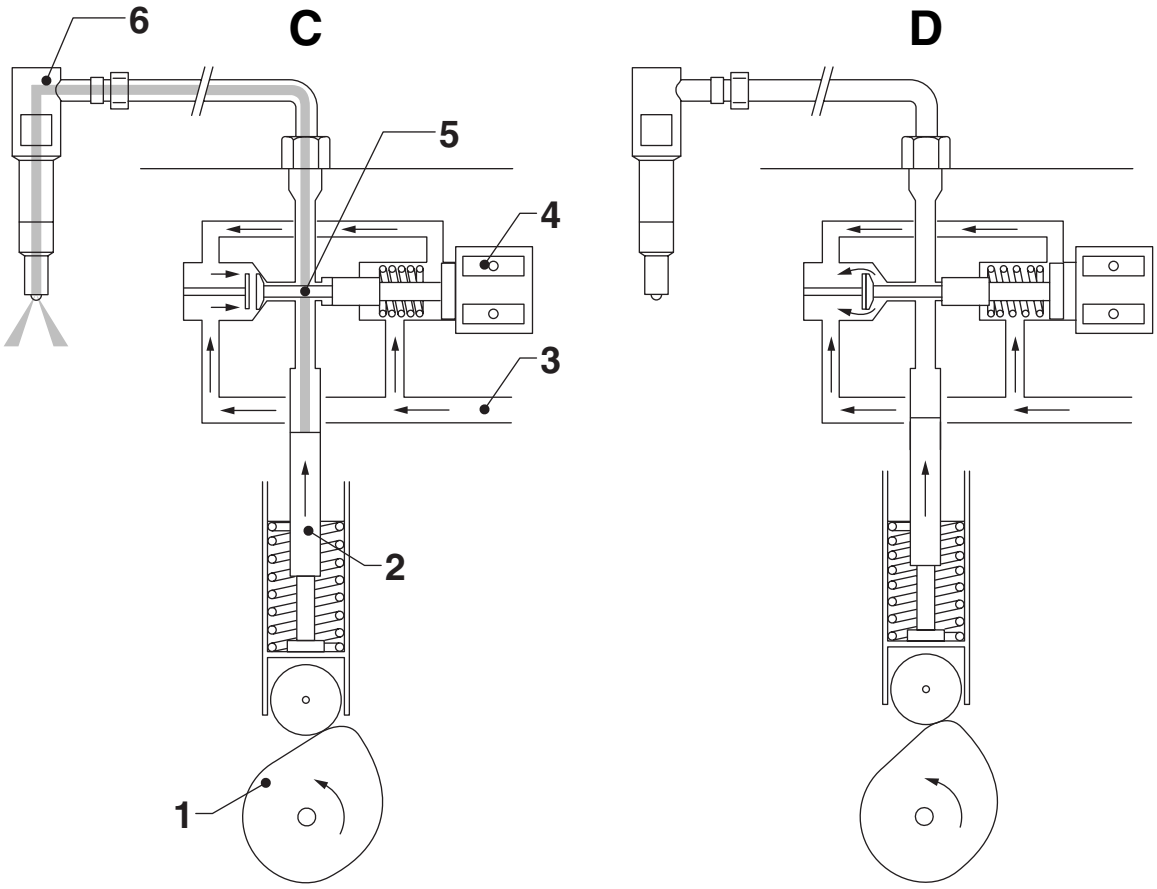
If the system has been 'open', the fuel system can be bled by means of the integrated primer pump in the fuel lift pump (3).

Pump unit
Operating principle



Situation A
In this situation the pump plunger (2) makes the suction stroke.
Due to the constant overpressure in the supply area of the fuel system, the high-pressure area above the pump plunger (2) is filled via the fuel supply ducts (3).

Situation B
In this situation the pump plunger (2) makes the compression stroke.
As the valve (5) has not yet closed the link to the fuel supply ducts (3), there is no pressure build-up.



i400427

Situation C
In this situation, the injection timing is determined.
The solenoid valve (4) is activated by the electronic unit.
In this way, the valve (5) closes the link between the space above the pump plunger (2) and the fuel supply ducts (3).
There is now a pressure build-up above the pump plunger (2), causing fuel to be injected via the injector (6).

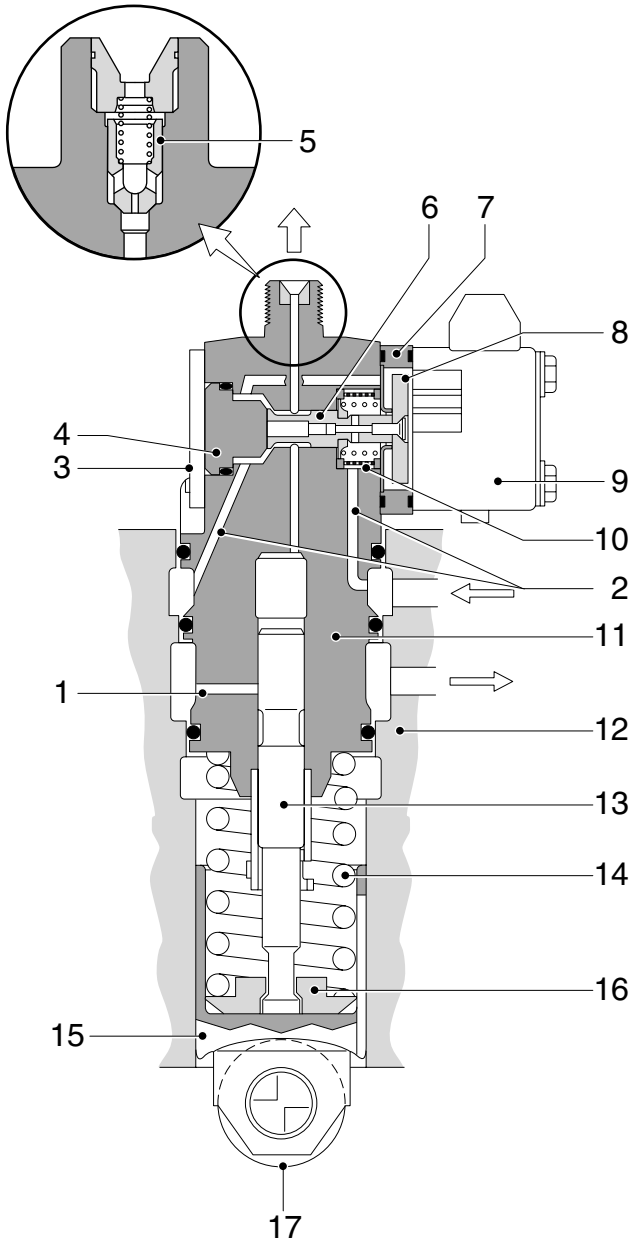
Situation D
In this situation the quantity of fuel to be injected is determined.
The solenoid valve (4) is no longer activated by the electronic unit
The valve (5) opens the connection between the space above the pump plunger (2) and the fuel supply ducts (3).
The fuel pressure above the pump plunger (2) will be quickly reduced.

The valve (6), back plate (8) and the pump plunger (13) are located in the top of the pump unit.
These parts are lubricated by the fuel.
A roller (17), tappet (15) and a spring (14) with spring retainer (16) are situated on the bottom of the pump unit.
These parts are lubricated by the engine lubrication system.
The lower sealing ring on the pump unit separates the fuel system from the engine lubrication system.

A pressure valve (5) is fitted on the top of the pump unit.
The function of the pressure valve is to prevent the supply section from being interrupted by pressure peaks from the injector pipe.

The injection timing and the quantity of fuel to be injected are controlled by a solenoid valve (9) that consists of an electromagnet and valve (6) with back plate (8), via the electronic unit control.

If the solenoid valve (9) is not energised, the valve (6) is forced against the valve stop (4) by the force of the valve spring.
This creates a very small opening between the space above the pump plunger (13) and the supply ducts (2).



i 400434

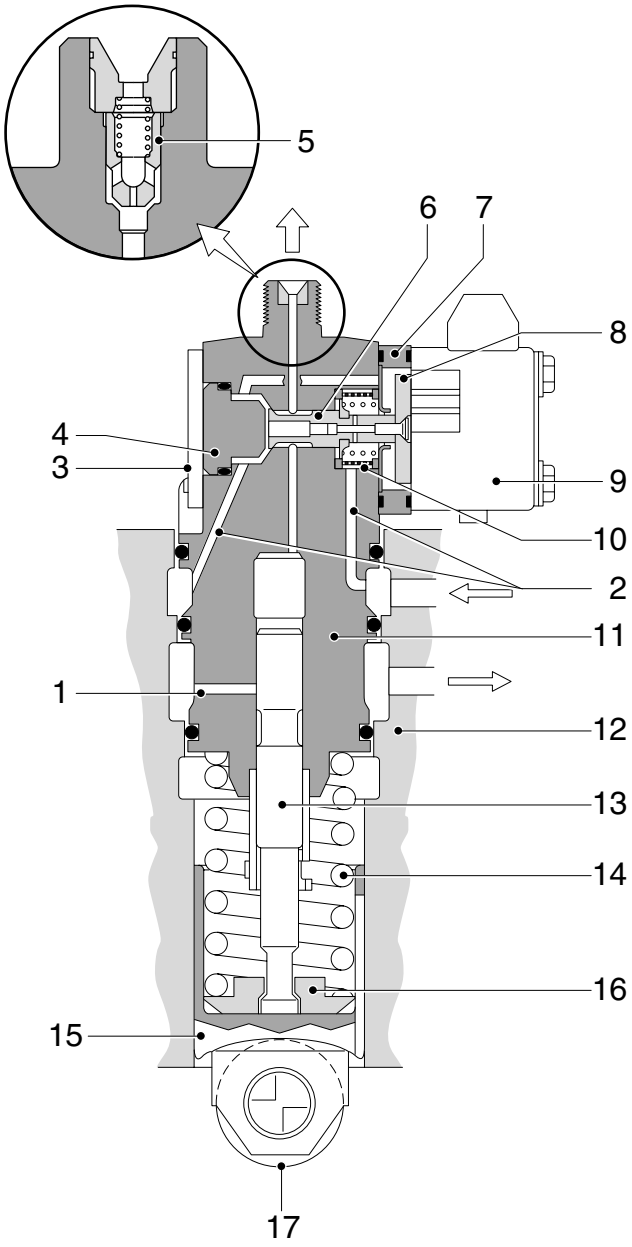
8

If the solenoid valve (9) is energised by the electronic unit, the back plate (8) with the valve (6) will be attracted by the electromagnet due to the influence of the magnetic field.
The valve (6) closes the connection between the space above the pump plunger (13) and the supply ducts (2), causing pressure to build up in the space above the plunger (13).
This causes the injection.

The fuel will now flow via the fuel supply ducts (2) to the space above the pump plunger (13).

The valve (6) is not re-opened against the force of the magnet by the high-pressure in the high-pressure area, as the forces in the valve (6) slot are balanced.
In other words, the left and right surfaces in the valve (6) slot are equal.

The time at which the valve (6) shuts depends on the injection timing calculated by the electronic unit.
The time that the valve (6) remains closed, and therefore the quantity of fuel injected, is also calculated by the electronic unit.

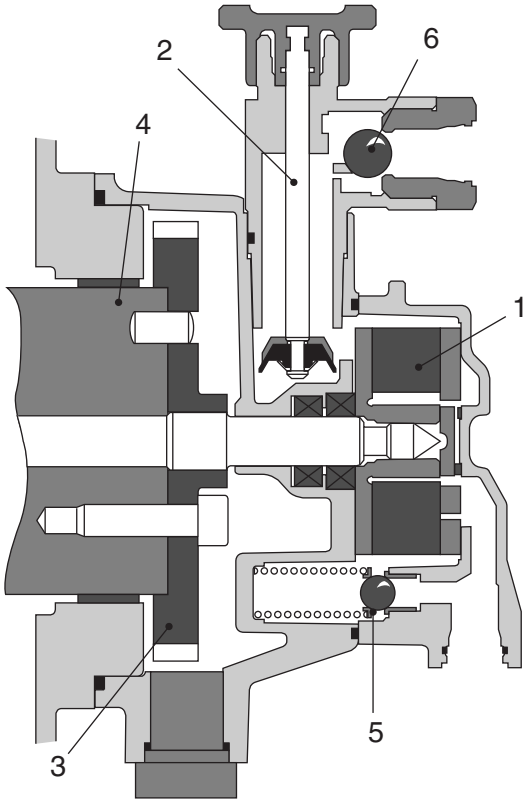


i 400435

8

2.3 DESCRIPTION OF COMPONENTS

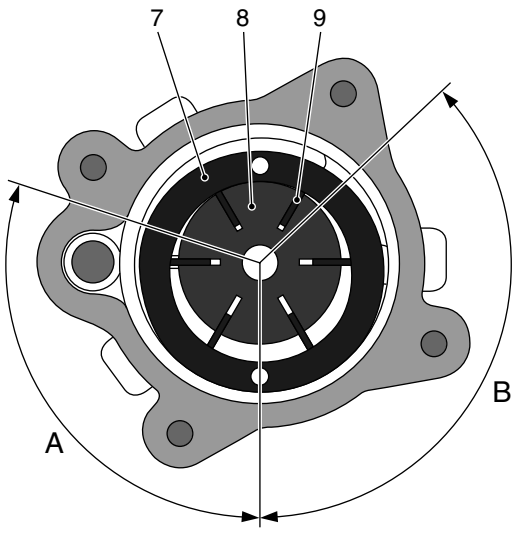
Fuel lift pump with integrated primer pump
The fuel lift pump with integrated primer pump is fitted to the rear of the pump housing. The fuel lift pump section (1) is driven via the pulse plate (3) by the camshaft (4) in the pump housing.
The fuel lift pump (1) is a vane pump.



I400428

The vane pump consists of a stator (7) in which the rotor (8) with the vanes (9) can be found. The vanes (9) are forced against the surface of the stator (7) by the centrifugal force and two successive vanes form an enclosed space, the pump chamber. Due to the elliptically-shaped stator (7), with each revolution each pump chamber undergoes a volume increase, the suction stroke (angle A), a volume reduction and the compression stroke (angle B).
To achieve a good seal, the rear of the vanes are connected to the compression pipe of the pump. This forces the vanes against the stator with increased pressure, resulting in a good seal.

A pressure-relief valve (5) is fitted in the fuel lift pump to protect the fuel system against excessive fuel lift pump pressure caused by excessive flow resistance.



i 400433

8

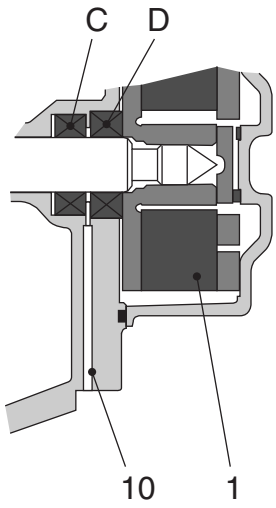
Note:
Excessive fuel lift pump pressure may damage the fuel filter element and/or leakage may occur along seals.

A primer pump (2) is fitted for bleeding the fuel system. To operate the primer pump (2), it must first be loosened.

On the upward stroke, the volume above the priming pump piston is reduced. This causes the non-return valve (6) to close and the fuel flows along the piston seal to the bottom of the piston.

On the downward stroke, the volume below the priming pump piston is reduced. This forces the fuel via the fuel lift pump section to the fuel fine filter.

At the bottom of the fuel lift pump is a pressure-relief area (10).
The pressure-relief area prevents fuel penetrating the lubrication system through sealing ring C and lubricating oil penetrating the fuel system through sealing ring D in the event of leakage.
A visual inspection for leaks is also possible with this.



I400432

8

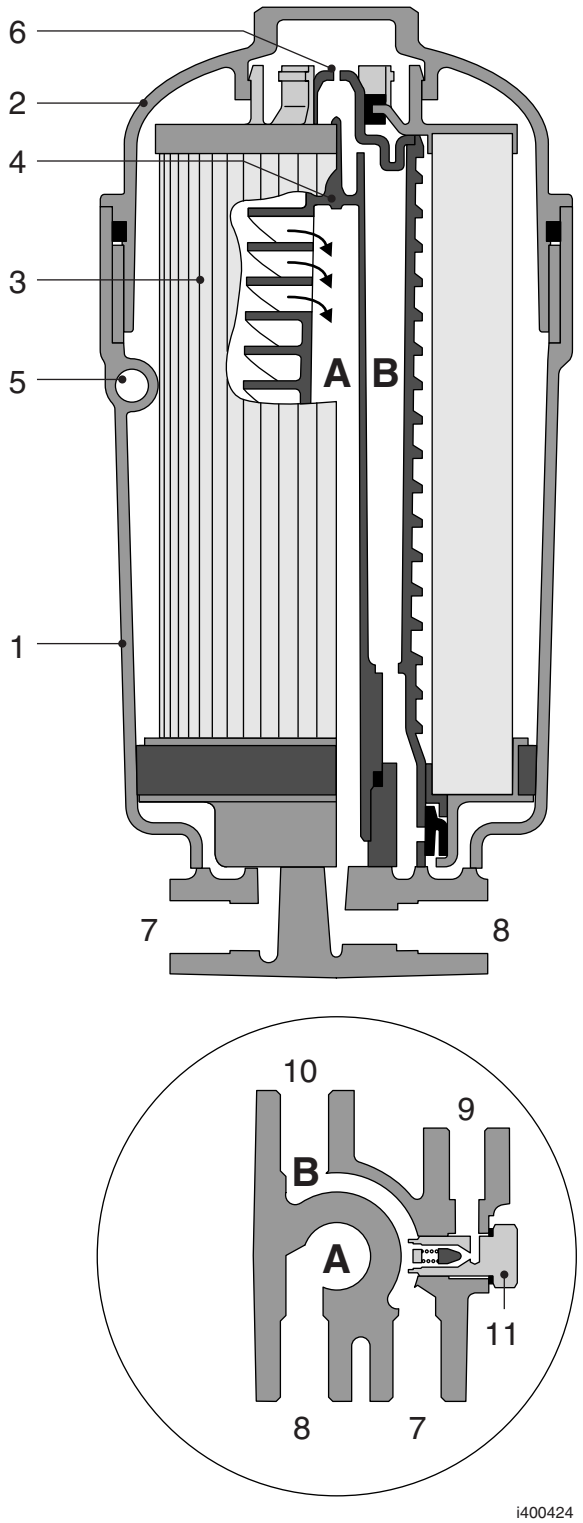
Fuel filter

The fuel filter consists of a filter housing (1) with a screw cap (2) in which the filter element (3) is secured. The inner section of the filter housing contains a central tube (4) with a supply side (A) and a permanent bleed side (B).

The fuel enters via connection (5) and is forced through the filter element (3). Within the filter element is the central tube (4) with the supply side (A) and a permanent bleed side (B). Via bores in the supply side (A), the filtered fuel passes to the pump housing.

A small section of the fuel and any air present enters via a calibrated hole (6) on the top of the central tube (4) in the permanent bleed side (B) and is led to the bottom of the filter housing.

At the bottom of the filter housing, a small amount of fuel and any air present are mixed with the leak-off fuel from the injectors (9) and the excess fuel from the pump housing (10). In the connection of the injector leak-off pipe is a banjo bolt with an integrated non-return valve (11). From the bottom of the filter housing, the excess fuel and any air present go back to the tank (7).



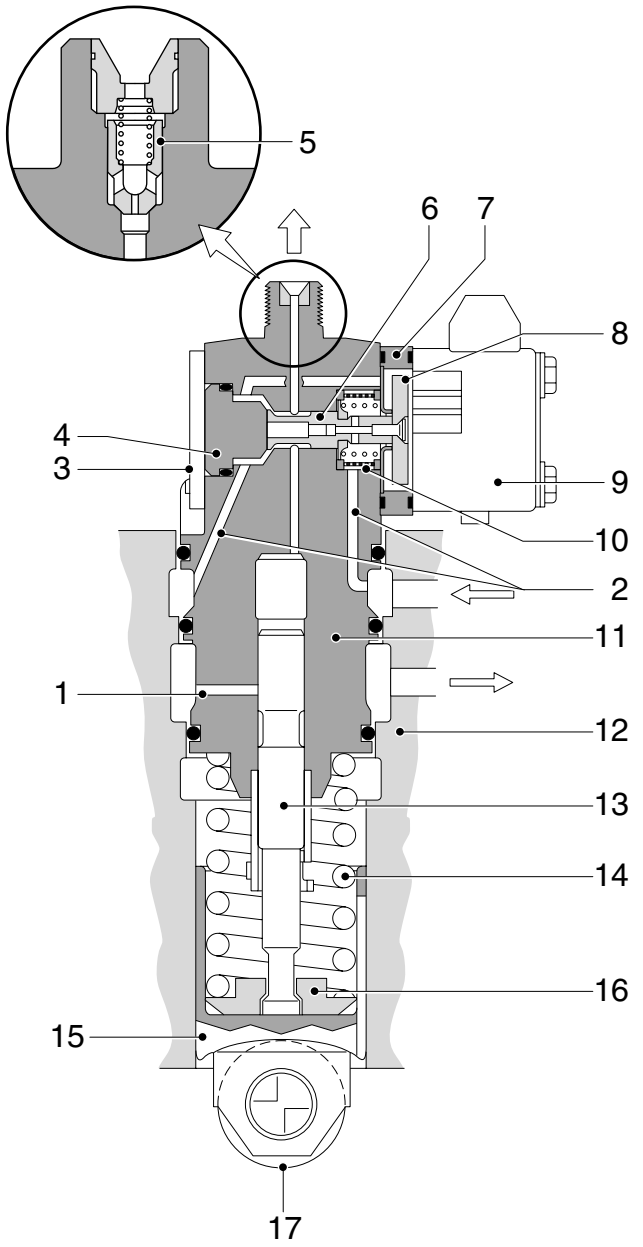
8

Pump unit
The valve (6), back plate (8) and the pump plunger (13) are located in the top of the pump unit.
These parts are lubricated by the fuel.
A roller (17), tappet (15) and a spring (14) with spring retainer (16) are situated on the bottom of the pump unit.
These parts are lubricated by the engine lubrication system.
The lower sealing ring on the pump unit separates the fuel system from the engine lubrication system.
A pressure valve (5) is fitted on the top of the pump unit.
The function of the pressure valve is to prevent the supply section from being interrupted by pressure peaks from the injector pipe.

The injection timing and the quantity of fuel to be injected are controlled by a solenoid valve (9) that consists of an electromagnet and valve (6) with back plate (8), via the electronic unit control.

If the solenoid valve (9) is not energised, the valve (6) is forced against the valve stop (4) by the force of the valve spring.
This creates a very small opening between the space above the pump plunger (13) and the supply ducts (2).

The fuel will now flow via the fuel supply ducts (2) to the space above the pump plunger (13).

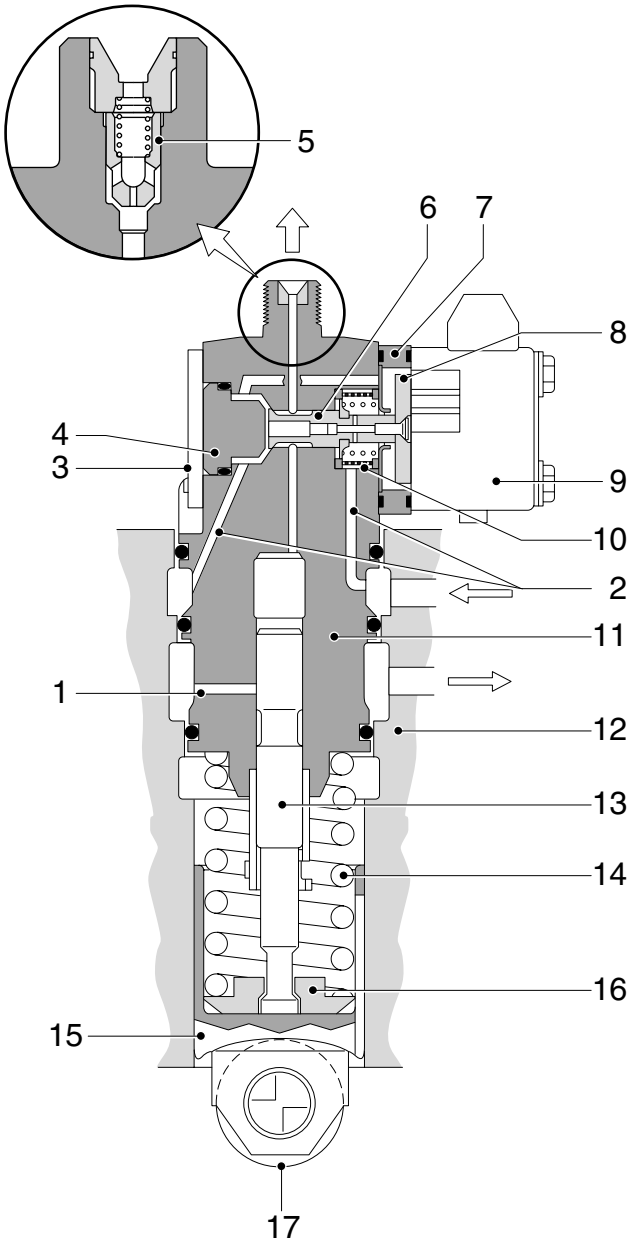


i 400434

If the solenoid valve (9) is energised by the electronic unit, the back plate (8) with the valve (6) will be attracted by the electromagnet due to the influence of the magnetic field.
The valve (6) closes the connection between the space above the pump plunger (13) and the supply ducts (2), causing pressure to build up in the space above the plunger (13).
This causes an injection.

The valve (6) is not re-opened against the force of the magnet by the high-pressure in the high-pressure area, as the forces in the valve (6) slot are balanced.
In other words, the left and right surfaces in the valve (6) slot are equal.

The time at which the valve (6) shuts depends on the injection timing calculated by the electronic unit.
The time that the valve (6) remains closed, and therefore the quantity of fuel injected, is also calculated by the electronic unit.



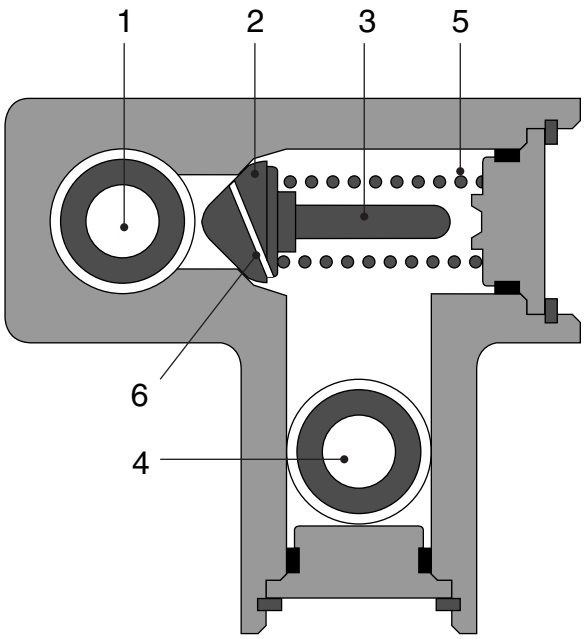
i 400435

Pressure relief valve

To guarantee a good degree of filling of the pump units, the end of the supply channel has a pressure-relief valve.
The pressure-relief valve connects the supply channel to the discharge channel.

The fuel flows into the entrance (1), past the piston (2) and the guide pin (3) and to the exit (4). The fuel encounters resistance due to the presence of the spring (5). This results in a pressure-relief valve opening pressure of approx. 5 bar.

The piston (2) has a diagonal bore (6). This bore is fitted for bleeding the fuel system.



i400423

8

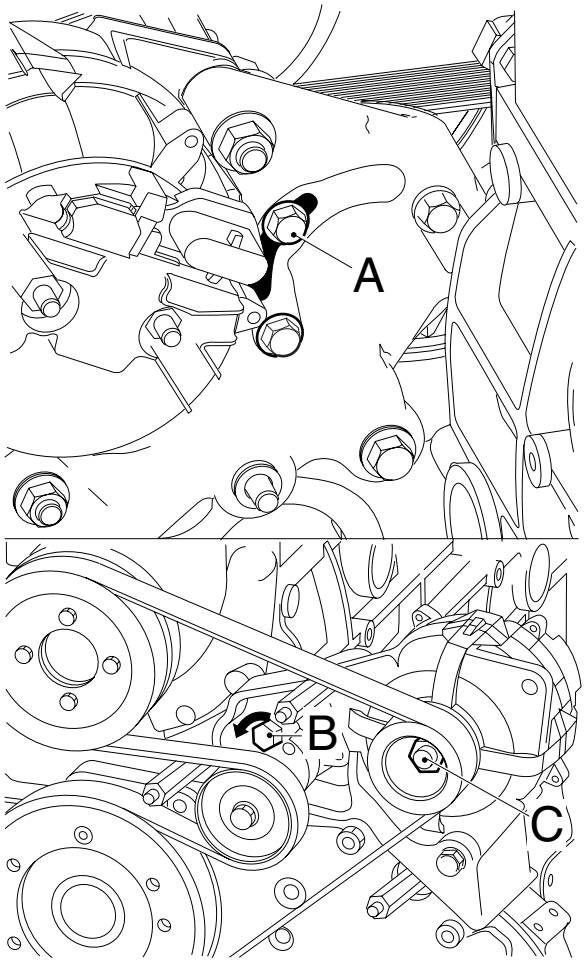
2.4 CRANKING THE ENGINE

Cranking using the tension pulley
Put an M8 x 90 bolt (A) into the tension pulley via the opening at the rear of the alternator bracket. Turn the bolt until the tension pulley blocks. Place a socket spanner on the nut (C) on the alternator and turn the engine clockwise.

Note:
Turning the nut anti-clockwise may cause the alternator nut to work loose.

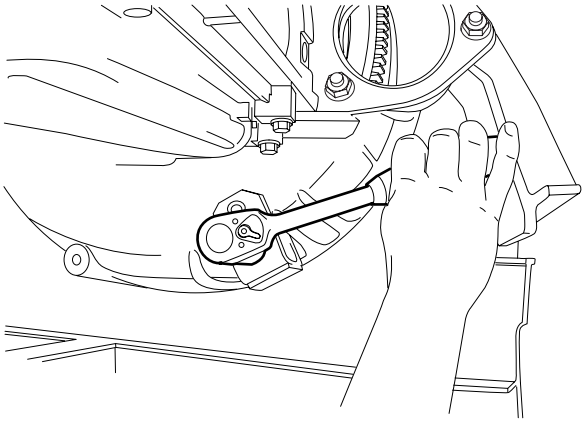
If the tension pulley slips while cranking, it can be pre-tensioned a little by turning it anti-clockwise (B) whilst securing the bolt (A).

Remove the blocking bolt (A) before the engine is started and check that the tensioner is no longer blocked.



M201273

Cranking on the flywheel housing
Fit the special tool (DAF No. 1310477) on the opening at the bottom of the flywheel housing such that the pinion engages the starter ring gear. Turn the crankshaft clockwise as seen from the timing gear end (this corresponds to the direction of rotation of the engine).


M201187

8

8

© 200324

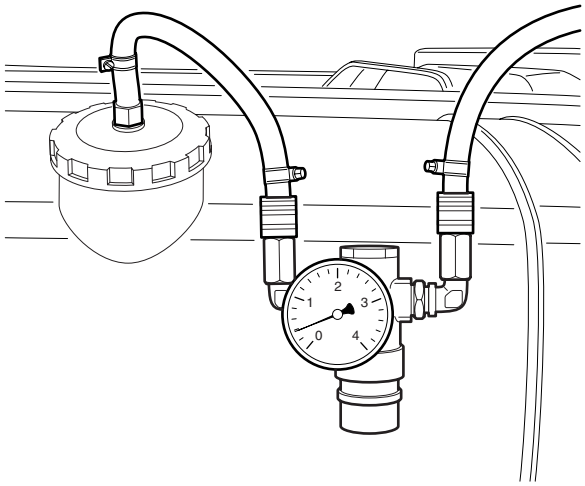
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTING FUEL LEVEL ELEMENT

To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

1. Fit a pressure reducer valve connection on a tank cap (without bleeder) and connect the tank cap to the fuel tank.
2. Pressurise the fuel tank (**maximum 0.1 bar**).
3. Slowly increase the pressure until the system audibly blows off via the pressure relief valve and check the opening pressure of the fuel level element. See "Technical data".
4. De-pressurise the fuel tank and remove the tank cap with the air connection.

   Note:
   To prevent dirt from entering, first clean the exterior of the fuel tank.

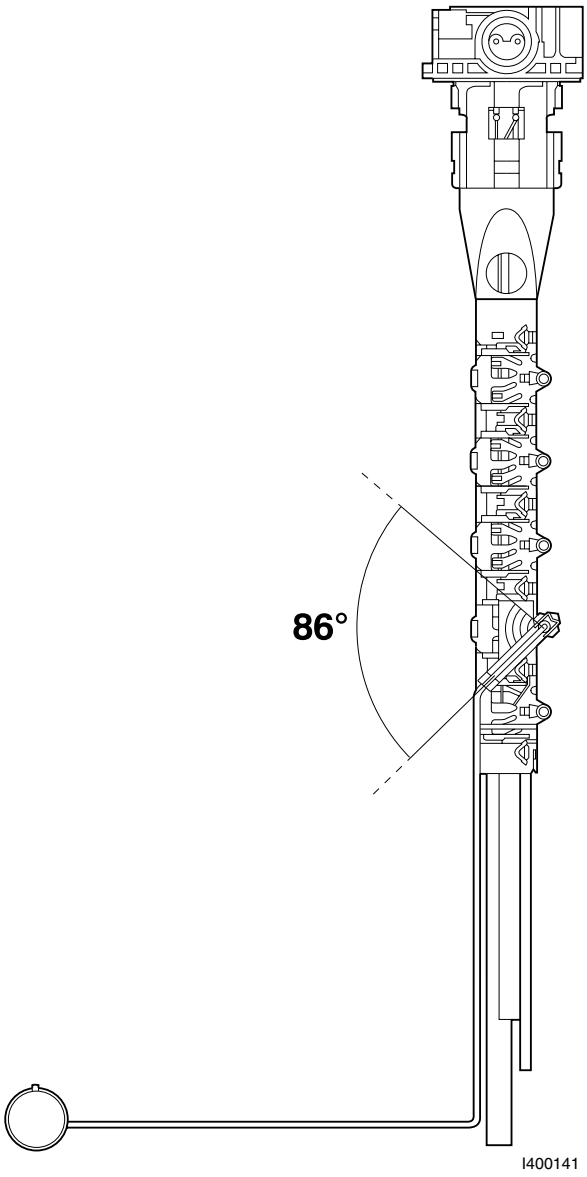


i400600

8

5. Remove the fuel level element.

6. Check the angular displacement of the fuel level element and the resistor value. See "Technical data".



8

© 200324

3.2 INSPECTING INJECTOR OPENING PRESSURE

Fuel or test fluid discharged by an injector may penetrate the skin, seriously harming your health. Make sure the fuel jet is discharged into a suitable container.

1. Disconnect the earth lead from the battery terminal.

2. Remove the fuel injector pipes as a set and close the connections on the pump units immediately.

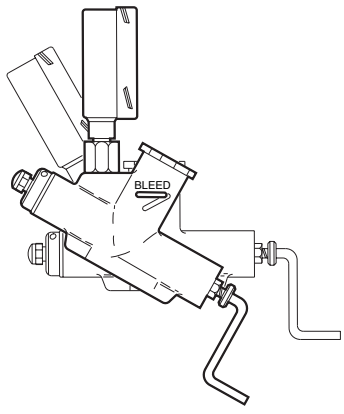
   Note:
   The opening pressure of the injectors can be tested using an injector test pump (DAF no. 0694966). The advantage of this method is that the injectors need not be removed from the engine.

3. Check the opening pressure of the injectors.

Instructions for the use of the injector test pump

1. Before the injector test pump is used, it must first be bled.
   Remove the pump reservoir filler plug and fill the reservoir with test fluid. The fluid level must be approximately 1 cm below the top rim.

2. Tilt the pump until the line with the word **"BLEED"** is horizontal.



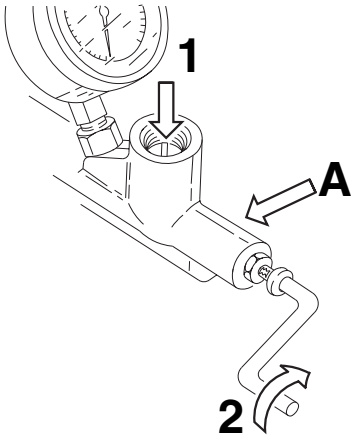
M4059

8

3. Press the bleed pin (1) and simultaneously turn the crank (2) clockwise to the stop. During this procedure, air bubbles will come to the surface in the reservoir. Now turn back the crank, fill the reservoir again and repeat the process until no more air bubbles come to the surface.
   Now release the bleed pin. Continue turning the crank until fuel escapes on the delivery side.

4. If necessary, fill the fuel reservoir and screw back the cap.

5. The pump is now ready for use.



M4058

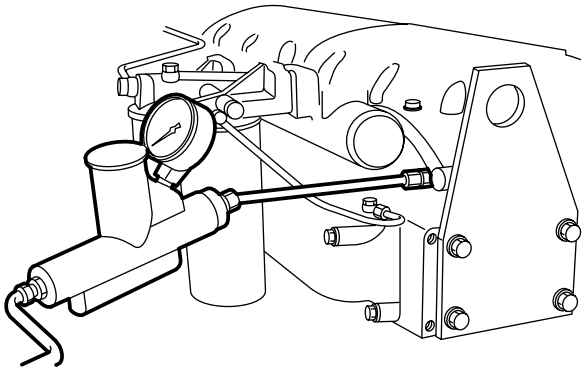
Inspecting opening pressure with an injector test pump

1. Keep the test pump more or less horizontal.

2. Loosen the test pump filler cap by half a turn so that air can enter the reservoir.

3. Turn the test pump crank clockwise. The compression will now start. Watch the fluid level in the test pump.

4. Carefully determine the opening pressure of the injector. There is no harm in repeating the test two or three times.


i 400190

If the test is repeated too often, however, the test fluid deposited on the piston may cause damage to the engine when it is started.

8

3.3 INSPECTING INJECTOR OPERATION

Fuel or test fluid discharged by an injector may penetrate the skin, seriously harming your health. Make sure the fuel jet is discharged into a suitable container.

Evaluating the injector's spray pattern, spray angle, and sound is practically impossible. New injectors or injectors that have been in use for some time cannot be tested in this way.

1. Place the injector on an injector tester.

2. First allow the injector to inject a number of times.

3. Inspect the injector for:
   - opening pressure
   - leakage
   - injector nozzles.

Opening pressure

1. Inspect the discharge pressure by slowly building up the pressure inside the injector.

Leakage

1. Dry the nozzle immediately after the final injection.

2. Increase the pressure to the opening pressure minus 20 bar. Within approx. 10 seconds, fuel must have ceased to leak from the nozzle. A moist nozzle is permitted. If the injector does not pass the oil leakage test, it must be replaced.

Injector nozzles

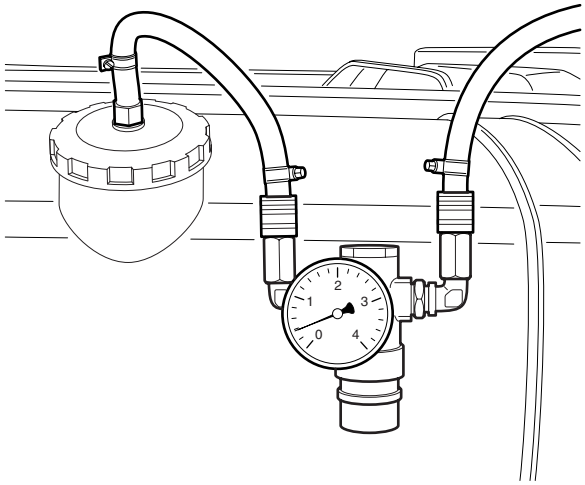
1. Quickly build up pressure in the injector and check whether all the nozzles are fully open.

2. Clean the injector if possible. See "Cleaning".

3.4 INSPECTING FUEL SYSTEM FOR LEAKAGE

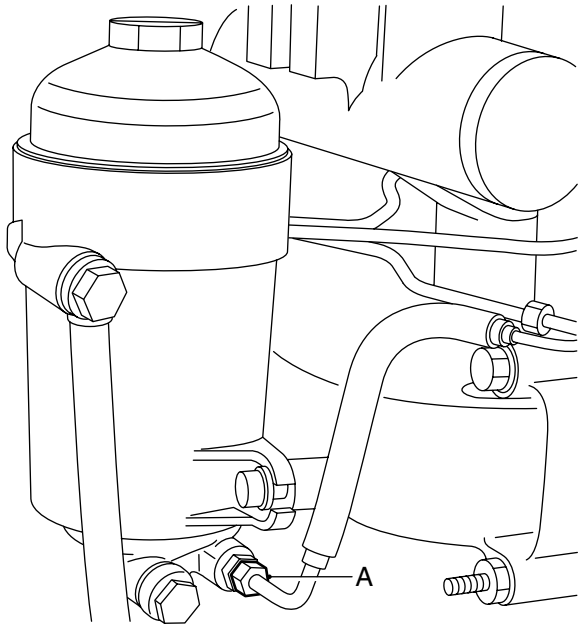
To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

1. Fit a pressure reducer valve connection on a tank cap (without bleeder) and connect the tank cap to the fuel tank.
2. Dry the inspection points.
3. Pressurise the fuel tank (maximum 0.2 bar).



i400600

4. Unscrew the union nut (A) a few turns to check whether there is leakage in the non-return valve. If there is leakage, the banjo bolt should be replaced.
5. Check the whole fuel system (low-pressure section) for leaks.
6. De-pressurise the system and replace the banjo bolt with integrated non-return valve on the rear of the filter housing with a normal banjo bolt.

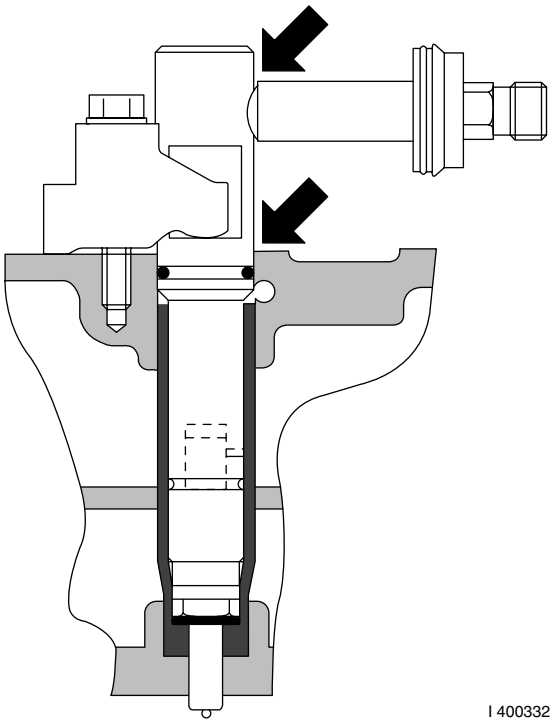


M201115

8

7. Remove the valve covers.
8. Re-pressurise the system (maximum 0.2 bar).
9. Check the permeable seal and the side-connection of the injectors for leaks.

   Note:
   Engine oil may be used to detect leaks at the O-ring.
10. Fit the valve covers.
11. Replace the normal banjo bolt with a banjo bolt with integrated non-return valve.


I 400332

3.5 BLEEDING THE FUEL SYSTEM

While bleeding the fuel system, fuel will escape. Collect the fuel to avoid the risk of fire.

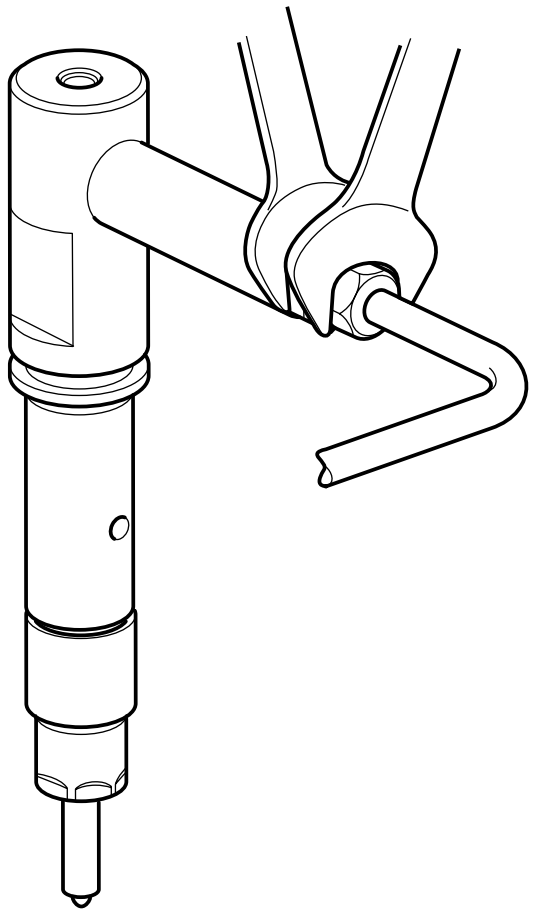
Dirt in the fuel system can lead to significant damage to pump units and housing.

Note:
The fuel system has to be bled if it has been opened; this can be done in two ways.

- With the fuel lift pump
- By pressurising the fuel tank

Bleeding using the fuel lift pump

1. Loosen the union nut on the injector.
2. Pump fuel out of the injector pipe with the primer pump until no more air bubbles are visible in the fuel.
3. Tighten the union nut to the specified torque, see "Technical data".
4. Repeat points 1, 2 and 3 for the other injectors.



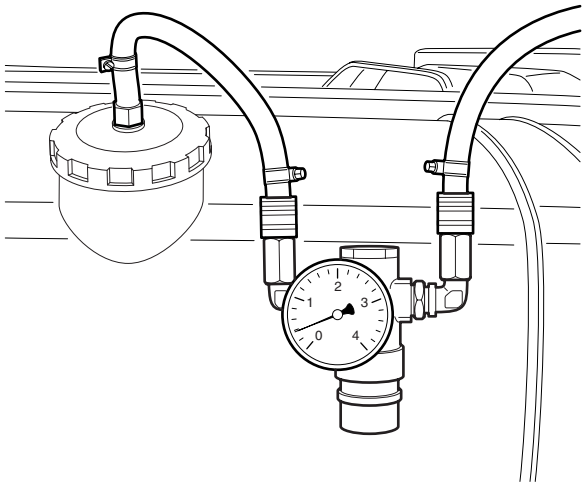
i 400237

Bleeding by pressurising the fuel tank

To prevent deformation of the fuel tank, the delivery pressure in the fuel tank must not exceed 0.4 bar.

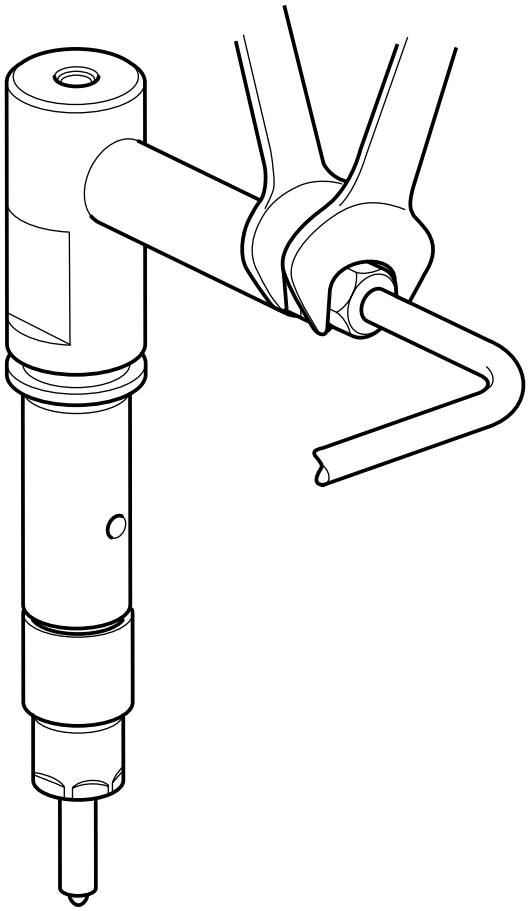
1. Remove the fuel tank cap and replace it by a cap with an adjustable air connection.

   Note:
   Use a cap (without a vent) that has a connection for a pressure reducer valve.



i400600

2. Pressurise the tank to a maximum of 0.2 bar.
3. Loosen the union nut on the injector.
4. Tighten the union nut to the specified torque, see "Technical data".
5. Repeat points 1, 2 and 3 for the other injectors.


i 400237

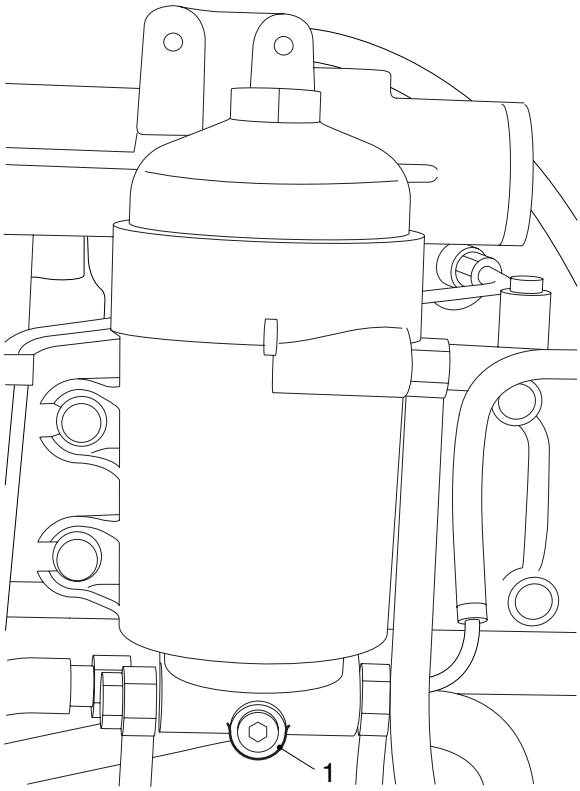
3.6 INSPECTION, GALLERY PRESSURE

When inspecting the gallery pressure, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

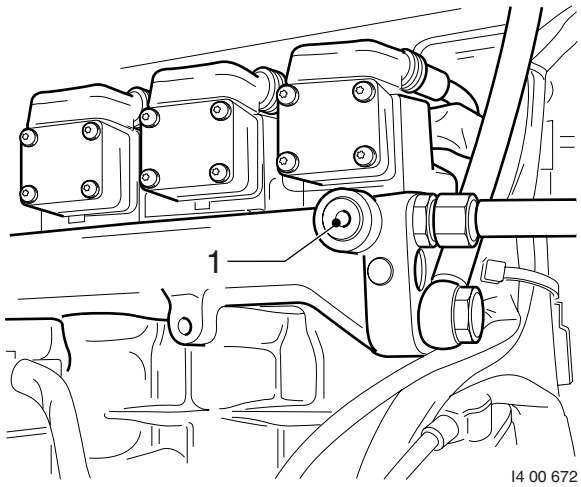
Dirt in the fuel system can lead to significant damage to pump units and housing.

1. Remove the plug (1) from the fuel fine filter or from the pump housing.
2. Connect an attenuated liquid pressure gauge with a range of 0 - 10 bar to the free connection point.

   Note:
   Before inspecting the gallery pressure at the starting speed, the fuses of the UPEC engine management system must be removed from the central box before and after ignition to stop the engine running and avoid fault messages.
3. Then check the gallery pressure at idling speed, full load and starting speed and compare the measured values to the specified values. See "Technical data".
4. Remove the pressure gauge and fit the plug (1).
5. Bleed the fuel system.



i400528



I4 00 672

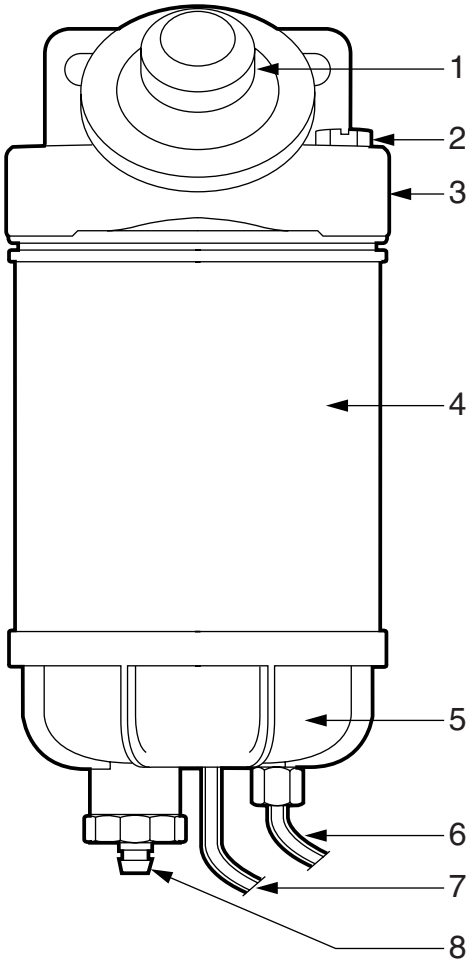
3.7 CHECKING THE FUEL PREFILTER/WATER SEPARATOR

Note:
If a fuel prefilter/water separator is fitted, there are two further versions.

"Racor" version

1. Check the reservoir (5) for water.

2. If necessary, drain the water off through the drain plug (8) using the fuel lift pump (1) and collect the water and fuel in a container.

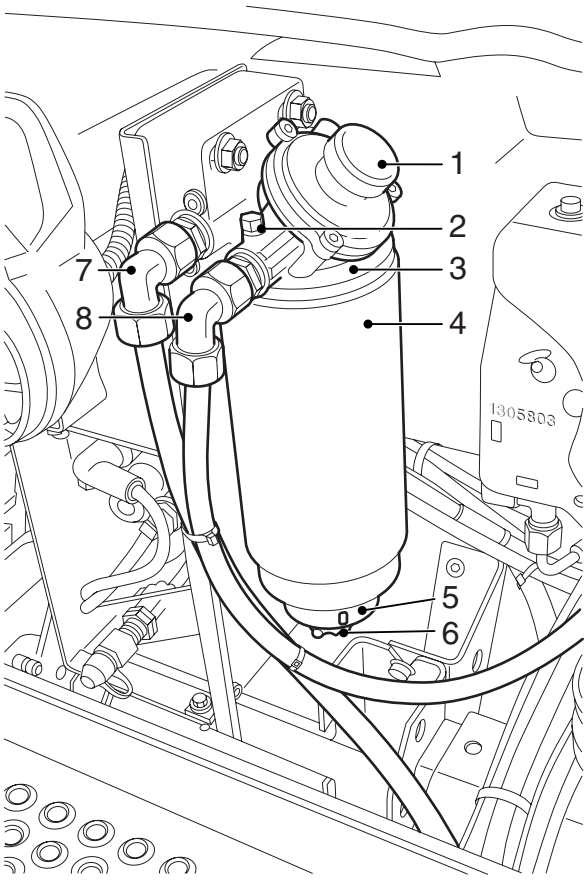


i400356

"Mann & Hummel" version

1. Check the reservoir (5) for water.

2. If necessary, drain the water off through the drain plug (6) using the fuel lift pump (1) and collect the water and fuel in a container.



8

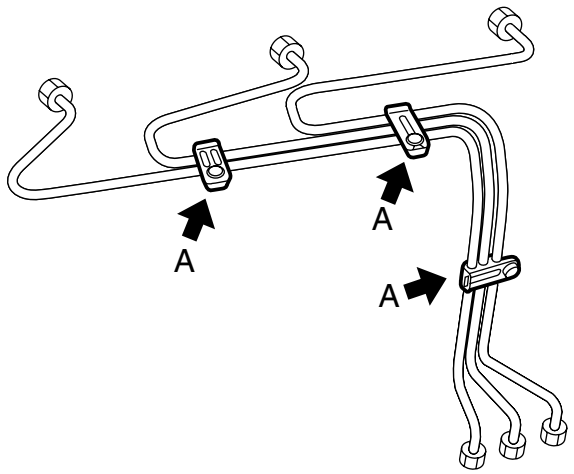
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, FUEL INJECTION PIPE

Removing the fuel injection pipe

Always leave the injection pipes fixed together as a complete set. Never remove or shift the clamping brackets (A) holding the pipes together. Never bend injector pipes as they may crack.

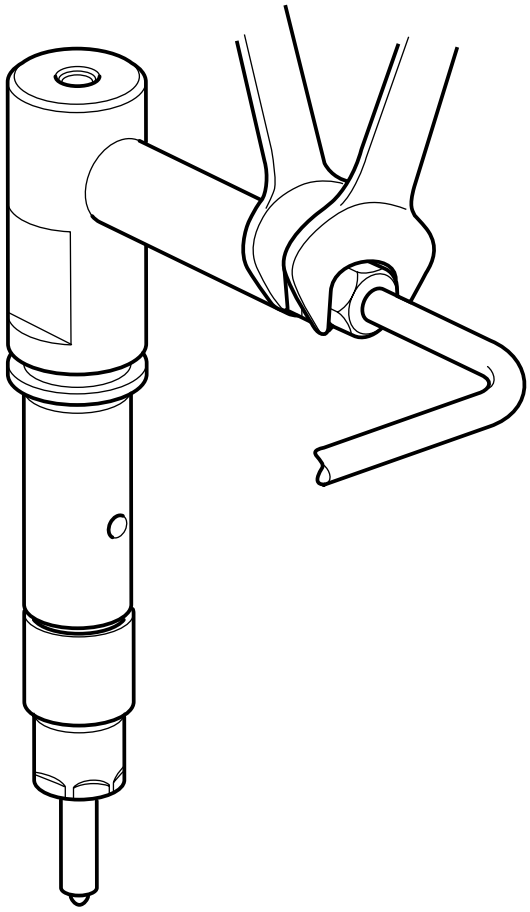
1. Disconnect the earth lead from the battery terminal.
2. Clean the union nuts and the area around both the injectors and the pump housing.



i 400199

When slackening the injection pipe union nuts, hold the injector's side connection back using an open-end spanner. If this is not done, there is a good chance that the side connection will leak. Immediately plug the openings.

3. Remove the fuel injection pipes as a set.



i 400237

8

Installing the fuel injection pipe

1. Blow the injector pipes with dry compressed air.
   Then turn the injector side towards the injectors.

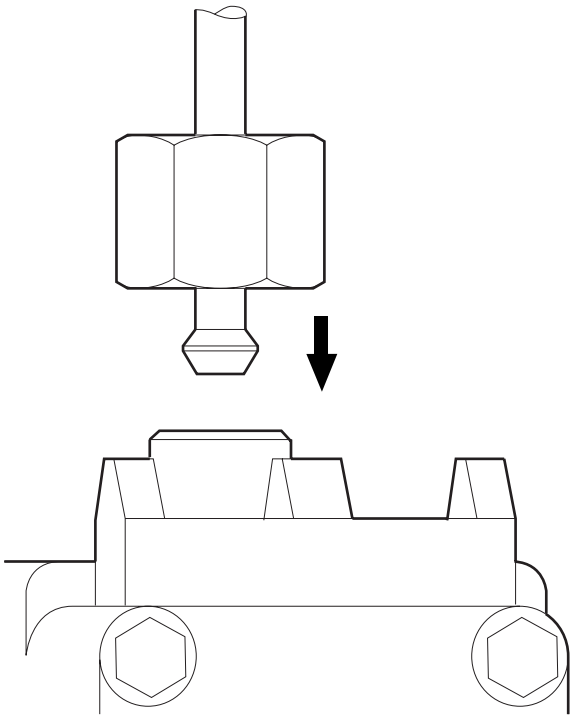
2. Position the set of injector pipes with the head on the connection of the pump unit (see diagram).

3. Tighten the union nuts to the pump connection by hand in the order 1-2-3 or 4-5-6.

4. Then tighten the union nuts on the injector side by hand in the order 1-2-3 or 4-5-6.

5. Then tighten the union nuts on the pump side in the order 1-2-3-4-5-6. Tighten them to the specified torque. See "Technical data".

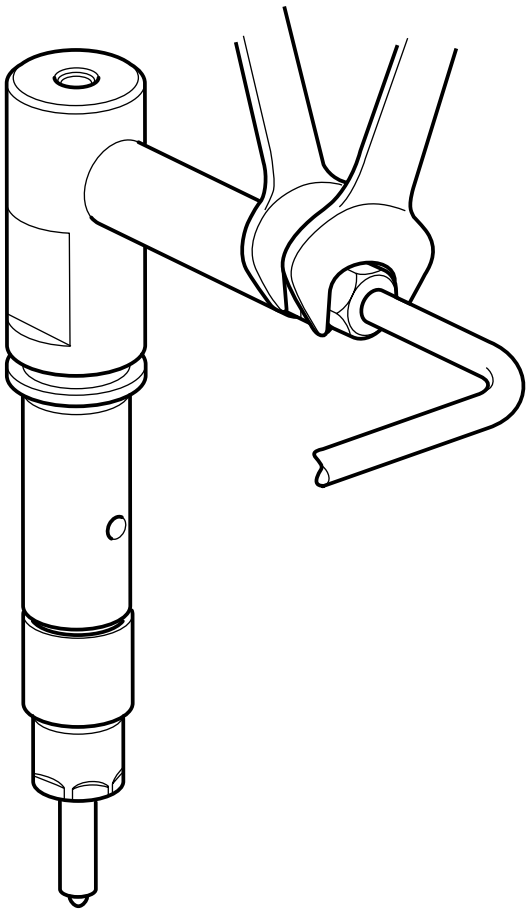
6. Now tighten the union nuts on the injector side in the order 1-2-3-4-5-6.



i400506

When tightening the injector pipe union nuts, hold the injector's side connection back using an open-end spanner. If this is not done, there is a good chance that the side connection will leak.

7. Tighten the injector pipe union nuts to the specified tightening torque. See "Technical data".



i 400237

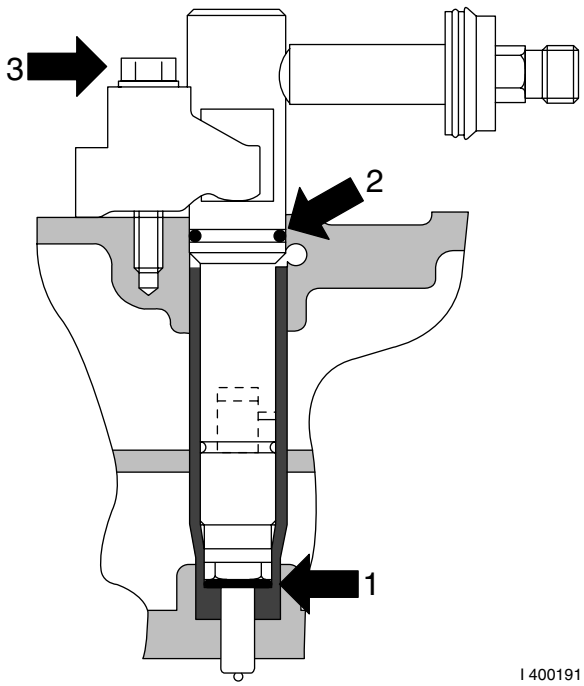
4.2 REMOVAL AND INSTALLATION, INJECTOR

Due to the presence of overpressure in the fuel tank, fuel may run into the cylinders when removing injectors. Therefore, when removing injectors, always first remove the tank cap. Collect any fuel from the injectors.

Removing the injector

1. Disconnect the earth lead from the battery terminal.
2. Remove the injector pipes as a set.
3. Remove the valve cover.
4. Remove the DEB.
5. Remove the attachment bolt (3) from the injector clamp. To remove the injector and the clamping piece, **only** use the special tools (DAF no. 1329412) and (DAF no. 0694928).

   Note:
   If during removal one or more copper shims (1) remain in the injector sleeve, the injector will be reinstalled in a higher position.
   As a result, instead of spraying into the combustion chamber of the piston, the fuel will be sprayed onto the piston ring. This may seriously damage the piston.
   There will be inadequate sealing between the O-ring (2) of the injector and the cylinder head. Fuel leaking from the injector can flow freely into the engine and dilute the lubricating oil.



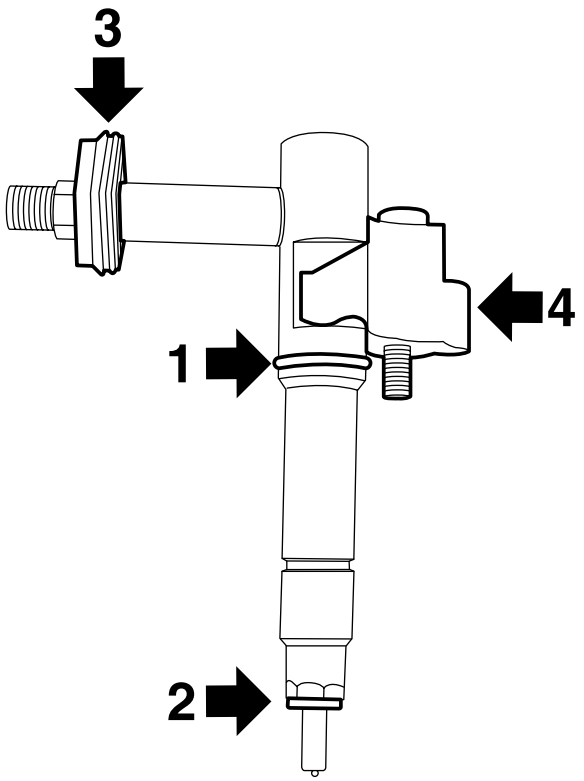
I 400191

8

Installing the injector

1. Clean the injector sleeve. See "Cleaning".
2. Fit a new O-ring (1) and a new copper shim (2) to the injector. Apply a little acid-free grease to both rings.
3. Inspect the valve sleeve seal (3) of the injector. Replace it if it is leaking and/or damaged.

   Note:
   Make sure that the injector clamp is installed correctly.
4. Fit the injector together with the injector clamp (4) and tighten the attachment bolt to the specified torque. See "Technical data".
5. Fit the DEB.
6. Adjust the DEB clearance.



i 400183

8

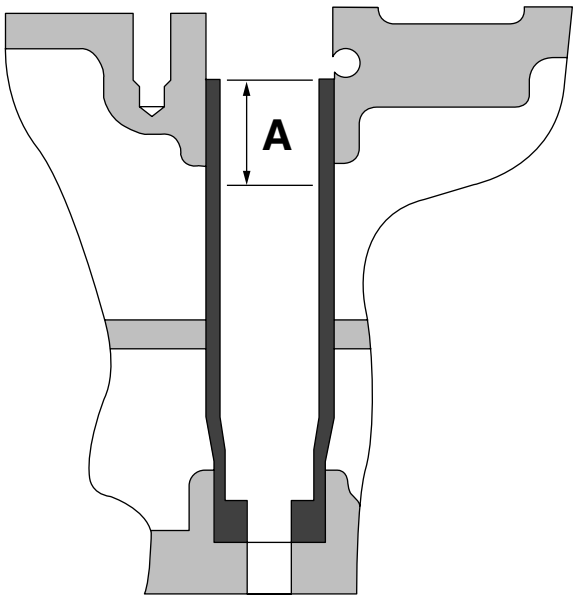
4.3 REMOVAL AND INSTALLATION, INJECTOR SLEEVE

Removing the injector sleeve

1. Partially drain the coolant.

2. Remove the injector.
   Insert a ball of crumpled paper into the injector sleeve to prevent metal particles from entering the engine.

3. Tap a thread (M22 x 1.5) over a length (A) of approx. 20 mm in the injector sleeve that is to be removed.
   Turn the special tool (DAF no. 1310425) into the injector sleeve and, using the special tool (DAF no. 0694928), remove the injector sleeve.



I 400195

Installing the injector sleeve

1. Clean the injector sleeve opening thoroughly.

   Note:
   Fit the **dry** injector sleeve in the cylinder head.
   Use the special tool (DAF no. 1329305) to tap the injector sleeve into the cylinder head.

2. Fit the injector.

3. Top up the cooling system.

4. Start the engine and check the engine for leaks.

8

4.4 REMOVAL AND INSTALLATION, PUMP UNIT

When removing the pump unit, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

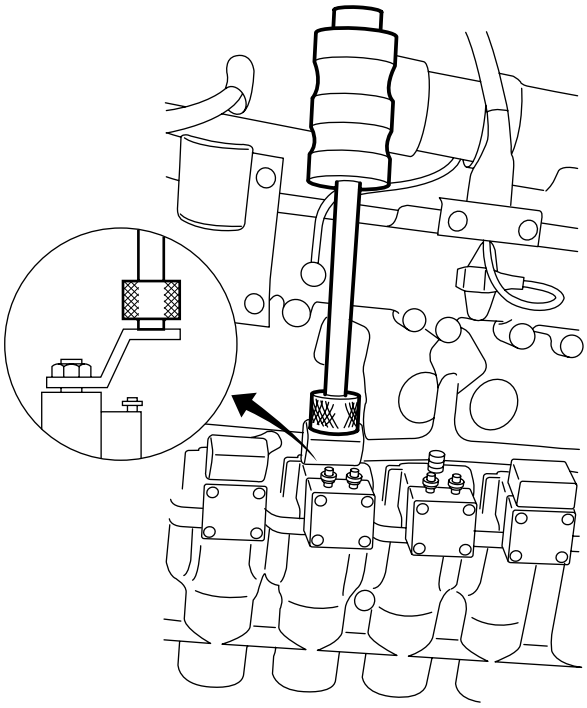
Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the pump unit

1. Disconnect the earth lead from the battery terminal.
2. Remove the electrical connections from the pump unit.
3. Remove the fuel pipes from the pump housing.
4. Remove the pressure relief valve from the pump housing.
5. Let the fuel leak from the pump housing.
6. Remove the injector pipes in sets and plug the pump units and injectors so that no dirt can enter.
7. If it is necessary to replace the pump unit(s), the pump unit must be marked so that it can be replaced in the same position in the pump housing.

   Note:
   The pump unit may be under spring tension, depending on the position of the camshaft in the pump housing.
8. Remove the attachment bolts from the pump unit.

9. Remove the pump unit. If necessary use the special tools (DAF no. 0694928) and (DAF no. 1329448).

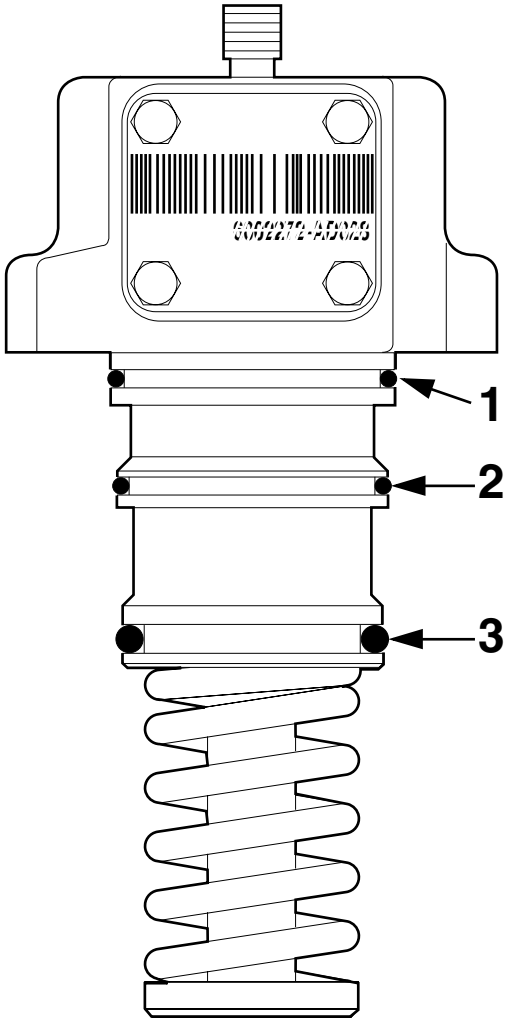


i 400396

Installing the pump unit

Note:
Damage to the sealing ring could result in the lubricating oil being diluted.

1. Fit new sealing rings to the pump unit. Sealing ring 1 has the largest diameter and sealing ring 3 the smallest.
2. Apply a thin layer of lubricating oil to the bores in the pump housing for the sealing rings.
3. Crank the engine until the camshaft in the pump housing is in such a position that the pump unit can be fitted in the pump housing practically tension free.
4. Apply a thin layer of lubricant to the new sealing rings and fit the pump unit, without damaging the sealing rings, in the pump housing.
5. Fit the pump unit attachment bolts and tighten them evenly until the pump unit abuts the pump housing.
6. Tighten the attachment bolts to the specified torque. See "Technical data".
7. Fit the pressure relief valve onto the pump housing.
8. Fit the fuel pipes to the pump housing.
9. Fit the injector pipes.
10. Fit the electrical connections to the pump unit.
11. Bleed the fuel system. See "Inspection and adjustment".



i 400221

8

4.5 REMOVAL AND INSTALLATION, FUEL LIFT PUMP

When removing the fuel lift pump, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the fuel lift pump

1. Disconnect the earth lead from the battery terminal.
2. Remove the fuel pipes from the fuel lift pump.
3. Remove the attachment bolts from the fuel lift pump.
4. Remove the fuel lift pump.

Installing the fuel lift pump

1. Check the sealing ring of the fuel lift pump for damage. If required, replace the sealing ring.
2. Apply lubricating oil sparingly to the fuel lift pump sealing ring.
3. Fit the fuel lift pump.
4. Screw in the attachment bolts evenly and tighten them to the specified torque. See "Technical data".
5. Connect the fuel pipes.
6. Bleed the fuel system. See "Inspection and adjustment".

8

4.6 REMOVAL AND INSTALLATION, PUMP HOUSING

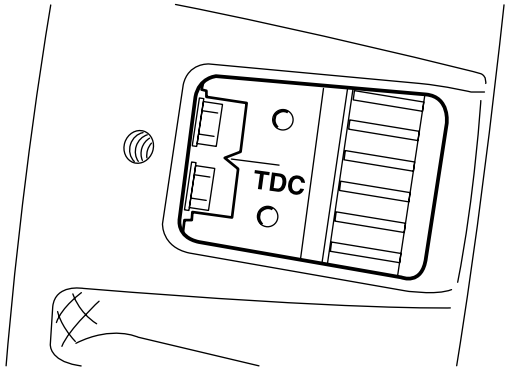
When removing the pump housing, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the fuel system can lead to significant damage to pump units and housing.

Removing the pump housing

1. Crank the engine until the valves of cylinder 6 are in overlap position and the TDC mark on the flywheel is in the correct position.

2. Remove the timing cover.



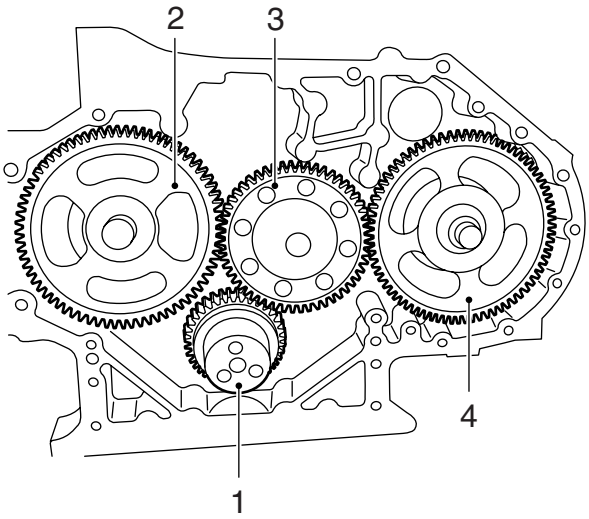
M201185

3. Remove the attachment bolt of the idler gear (3) and pump housing camshaft gear (4).

   Note:
   When the crankshaft (1) or the camshaft (2) without idler gear (3) is rotated separately, the engine's pistons may touch the valves.

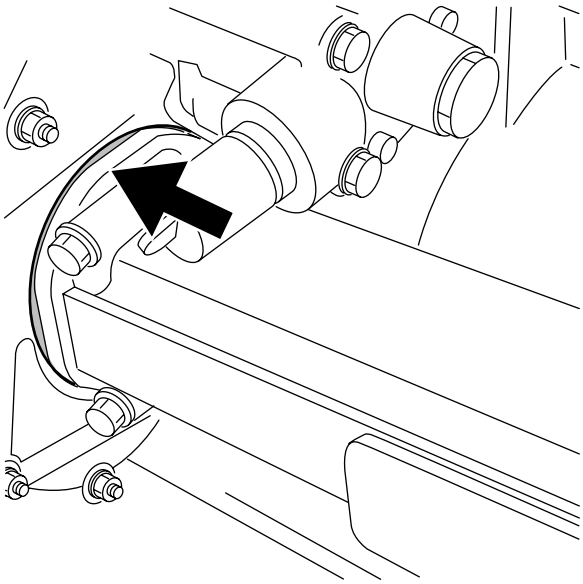
4. Remove the idler gear (3).

5. Remove the pump housing camshaft gear (4).



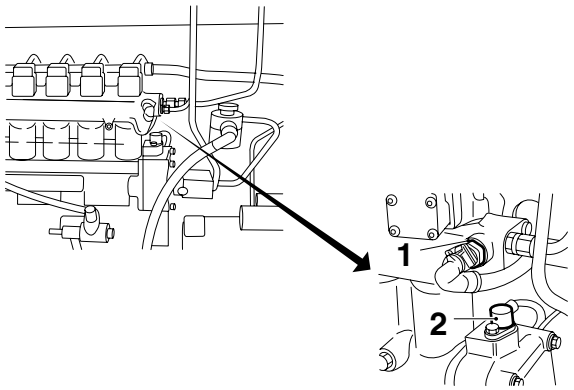
M200725

6. Remove the timing gear seal by tapping it out of the timing gear case in the driving direction.
7. Remove the electrical connections from the pump units.
8. Remove the fuel pipes from the pump housing.
9. Remove the pressure relief valve from the pump housing.
10. Let the fuel leak from the pump housing.
11. Remove the fuel pipes from the fuel lift pump.
12. Remove the fuel injection pipes and plug the pump units and injectors so that no dirt can enter the system.



M200728

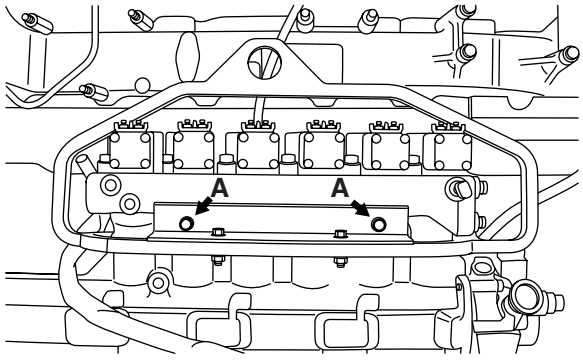
13. Remove the connector from the fuel temperature sensor (1) (if fitted on the pump housing).
14. Remove the camshaft position sensor (2).



i 400529

Due to the weight of the pump housing, use the special tool.

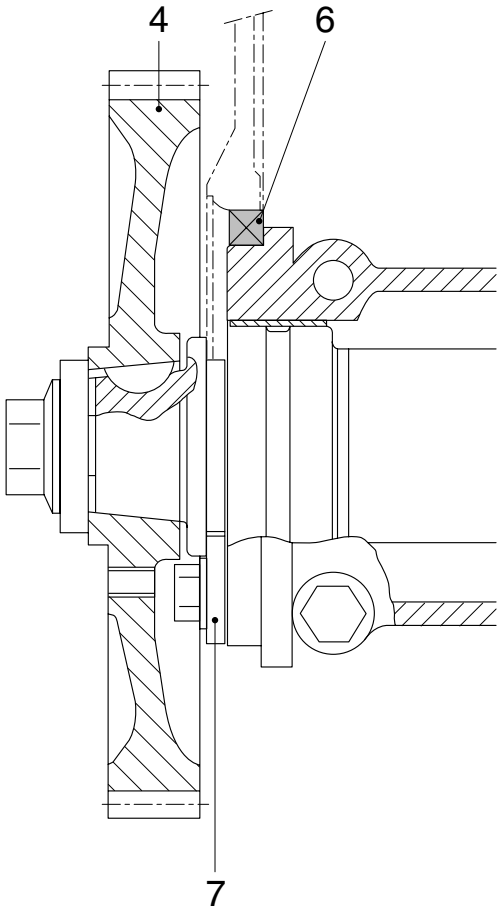
15. Fit the lifting gear (DAF no. 1329499) to the pump housing and tighten the bolts (A).
16. Remove the attachment bolts of the pump housing and lift the pump housing off the dowel pins on the engine block using the lifting gear.



i400601

Installing the pump housing

1. Fit two new lubricating oil connection sealing rings.
2. Fit the pump housing using the lifting gear (DAF no. 1329499). Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the camshaft position sensor.
4. Fit the fuel temperature sensor connector.
5. Fit the electrical connections onto the pump units.
6. Fit the injection pipes.
7. Connect the fuel pipes of the fuel lift pump.
8. Fit the pressure relief valve onto the pump housing.
9. Fit the fuel pipes to the pump housing.
10. Fit a dry new timing case seal (6) using the special tool (DAF no. 1329318).
11. Check whether cylinder 1 is at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).



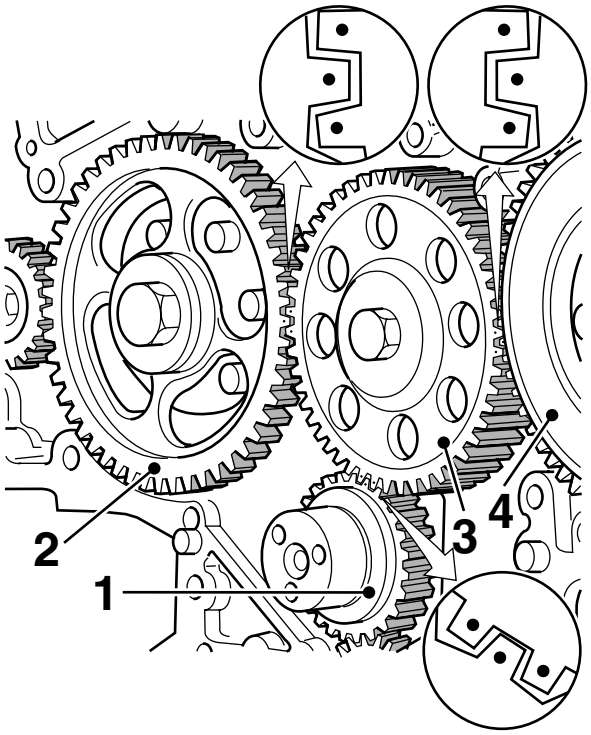
M200841

12. Fit the pump housing camshaft gear (4) in such a position that the idler gear (3) can be installed in accordance with the marks.

13. Fit the attachment bolts of the pump housing camshaft gear (4) and idler gear (3) and tighten to the specified torque. See "Technical data".

14. Fit the timing cover.

15. Bleed the fuel system. See "Inspection and adjustment".



M201281

4.7 REMOVAL AND INSTALLATION, FUEL PIPES

Removal, fuel pipes

1. Disconnect the earth lead from the battery terminal.

2. Disconnect the appropriate fuel pipe and collect the escaping fuel.

3. If the pipe is damaged in any way, it should be replaced.

Leaks from fuel pipes must be remedied as soon as possible to reduce fire risk.

Installation, fuel pipes

1. Always use new copper sealing rings during fitting.

2. Tighten union nuts and banjo bolts to the specified torque. See "Technical data".

Note:
In the event of a leakage from a pipe coupling, do not overtighten the union nut. First check whether the leak is at the connection point between the pipe and coupling or at the connection point between coupling and the component housing.

If the leakage has not stopped after the union nut has been tightened, it will be necessary to take the coupling apart.
Check the parts for deposits and/or damage.

Pipes may chafe if they touch each other or other parts of the vehicle.

Pipes showing evidence of wear must be replaced without delay.

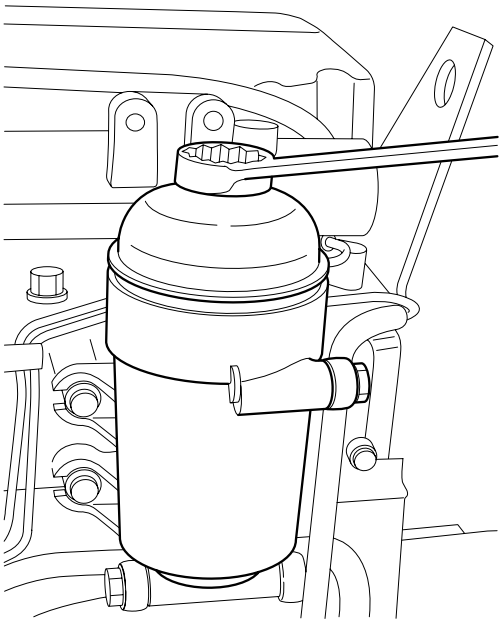
4.8 REMOVAL AND INSTALLATION, FUEL FILTER ELEMENT

When removing the fuel filter, a quantity of fuel will escape. Collect the fuel to avoid the risk of fire.

Removing the fuel filter element

1. Remove the cover together with the fuel filter element from the filter housing.

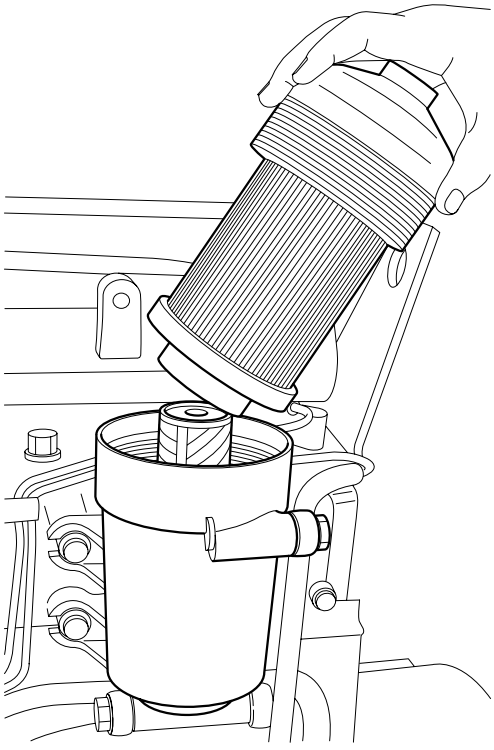
   Note:
   The fuel filter element is a disposable filter, and may not be cleaned and reused. Dispose of the filter as chemical waste.



i 400444

Fitting the fuel filter element

1. Replace the cover O-ring.
2. Fit the fuel filter element in the cover
3. Fit the cover with fuel filter element. Tighten the filter cover to the specified torque. See "Technical data".
4. Pump for approximately 1 minute using the primer pump to partially fill the filter housing with fuel.
5. Start the engine and run it at idling speed for a few minutes; this will allow any air in the filter housing to escape.
6. If the motor will not start up or runs very erratically, the fuel system must be bled, see "Draining and filling".
7. Check the fuel system for leaks.



i 400445

4.9 REMOVAL AND INSTALLATION, FUEL LEVEL ELEMENT

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Removal, fuel level element

1. Disconnect the earth lead from the battery terminal.

   Note:
   To prevent dirt from entering, first clean the fuel tank.

2. Remove the connector from the fuel level element.

3. Remove the fuel pipes from the fuel level element.

4. Turn the fuel level element a quarter turn anti-clockwise.

5. Carefully remove the fuel level element from the fuel tank.

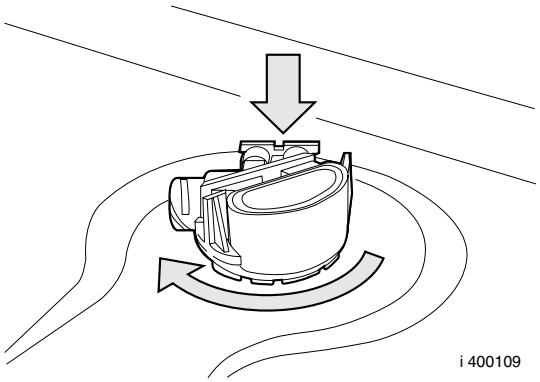
6. Replace the O-ring.

Installation, fuel level element

1. Check that the fuel pipes are fitted correctly in the tank filter.

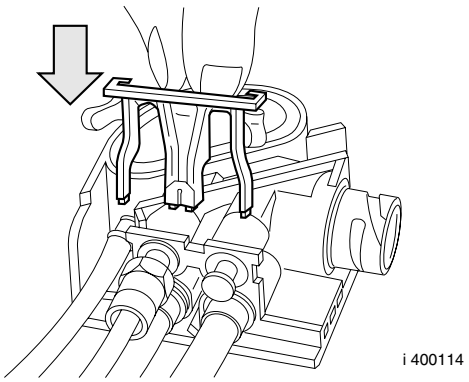
2. Fit the fuel level element carefully in the fuel tank.

3. Insert the fuel level element into the hole of the tank and turn it clockwise a quarter turn.



4. Insert the fuel pipes into the fuel level element.

5. Fit the connector of the fuel level element.


i 400114

4.10 REMOVAL AND INSTALLATION, FUEL TANK FILTER

When the fuel level element is removed, a quantity of fuel will escape. Collect this fuel, bearing in mind the risk of fire.

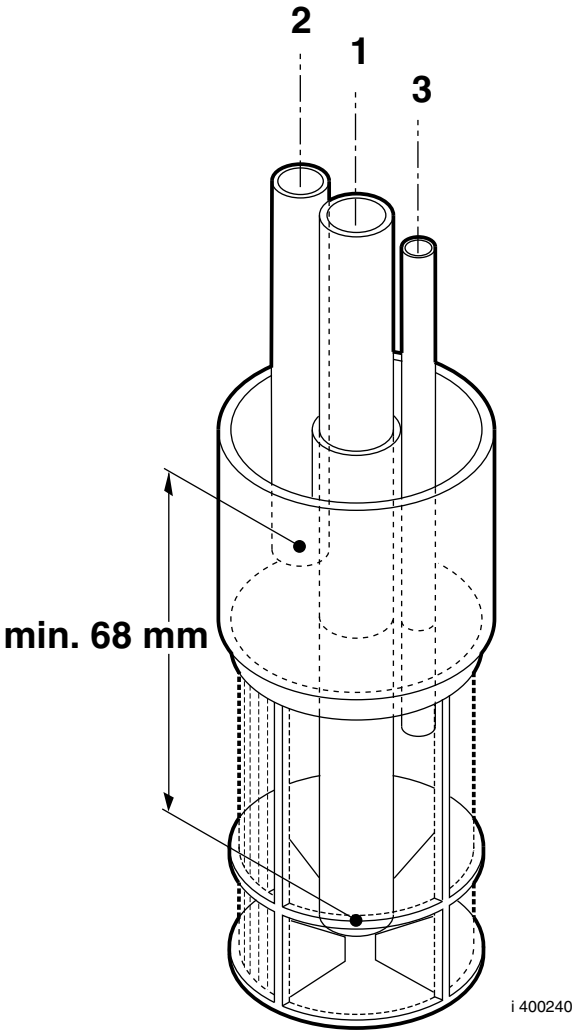
Removing fuel tank filter

1. Remove the fuel level element.
2. Remove the fuel tank filter.

Fitting fuel tank filter

1. Check that the difference in length between the supply pipe (1) and return pipe (2) is at least 68 mm.
2. Slide the fuel tank filter as far as possible onto the supply pipe (1).

   Note:
   Make sure that when fitting the fuel tank filter the return pipe (2) is inserted into the fuel tank filter by-pass and that the cab heater supply pipe (3), if present, is inserted into the filter part.
3. Fit the fuel level element.



4.11 REMOVAL AND INSTALLATION, FUEL PREFILTER/WATER SEPARATOR FILTER ELEMENT

When removing the fuel prefilter/ water separator, a quantity of fuel will escape. Collect the fuel to avoid the risk of fire.

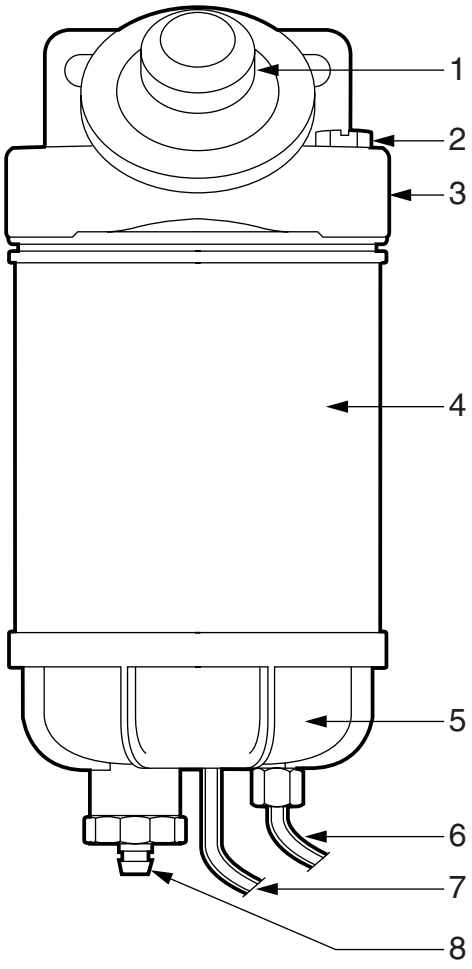
Version: Racor

Removing the fuel prefilter/water separator filter element

1. Drain the fuel from the filter element by unscrewing the bleed plug (2) and opening the drain plug (8).
2. If fitted, disconnect the water sensor (6) and the heating element (7) connectors.
3. Remove the filter element (4) and the bottom cover (5). Clean the O-ring seal.

Installing the fuel prefilter/water separator filter element

1. Apply a film of engine oil to the O-ring and the new sealing ring.
2. Fit the bottom cover (5) onto the new filter element (4).
3. Fit the bottom cover (5) together with the new filter element (4) to the filter housing (3).
4. Hand-tighten the new filter.
5. If fitted, attach the water sensor and heating element connectors.
6. Check whether the drain plug (8) is tight.
7. Open the air-bleeder plug (2) a couple of turns.
8. Operate the primer pump (1) until fuel comes out of the air-bleeder plug.
9. Close the air-bleeder plug (2).
10. Start the engine and check for leaks. If necessary, retighten the filter element (4) by hand.



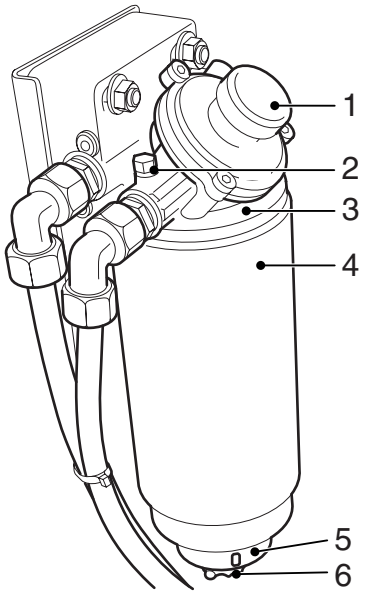
i400356

8

Version: Mann + Hummel

Removing the fuel prefilter/water separator filter element

1. Drain the fuel from the filter element by unscrewing the bleed plug (2) and opening the drain plug (6).
2. If fitted, unplug the connectors of the water sensor and the heating element.
3. Remove the filter element (4) together with the bottom cover (5) and clean the O-ring seal.



G0 00 266

Installing the fuel prefilter/water separator filter element

1. Apply a film of engine oil to the O-ring and the new sealing ring.
2. Fit the bottom cover (5) onto the new filter element (4).
3. Fit the bottom cover (5) together with the new filter element (4) to the filter housing (3).
4. Hand-tighten the new filter.
5. If fitted, attach the water sensor and heating element connectors.
6. Check whether the drain plug (6) is tight.
7. Open the air-bleeder plug (2) a couple of turns.
8. Operate the primer pump (1) until fuel comes out of the air-bleeder plug.
9. Close the air-bleeder plug (2).
10. Start the engine and check for leaks. If necessary, retighten the filter element (4) by hand.

8

5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, PUMP HOUSING

When disassembling the pump housing, fuel will escape. Collect this fuel, bearing in mind the risk of fire.

Dirt in the system can lead to significant damage to fuel system components.

Disassembling the pump housing

1. Remove the pump housing. See "Removal and installation".

   Note:
   If after removal the pump units are not replaced in the same position, they must be re-calibrated.

2. Remove the pump units. See "Removal and installation".

3. Remove the tappet rollers.

4. Remove the fuel lift pump. See "Removal and installation".

5. Remove the cover and check the O-ring. If necessary, replace the O-ring.

6. Remove the pulse disc from the pump camshaft.

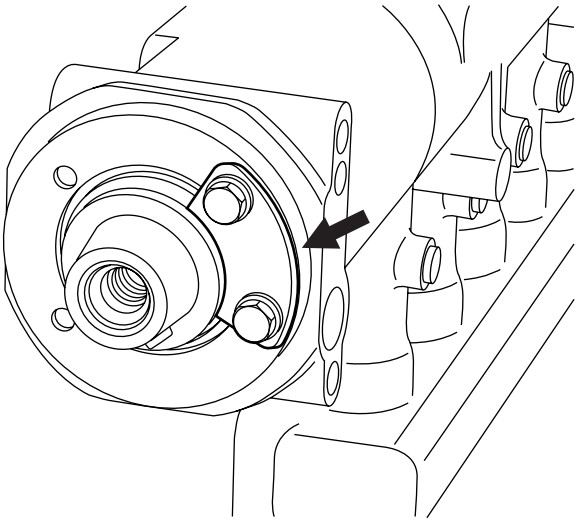
7. Remove the locking plate from the pump camshaft.

   Note:
   When removing the sealing plates, an amount of lubricating oil will escape. Collect this lubricating oil.

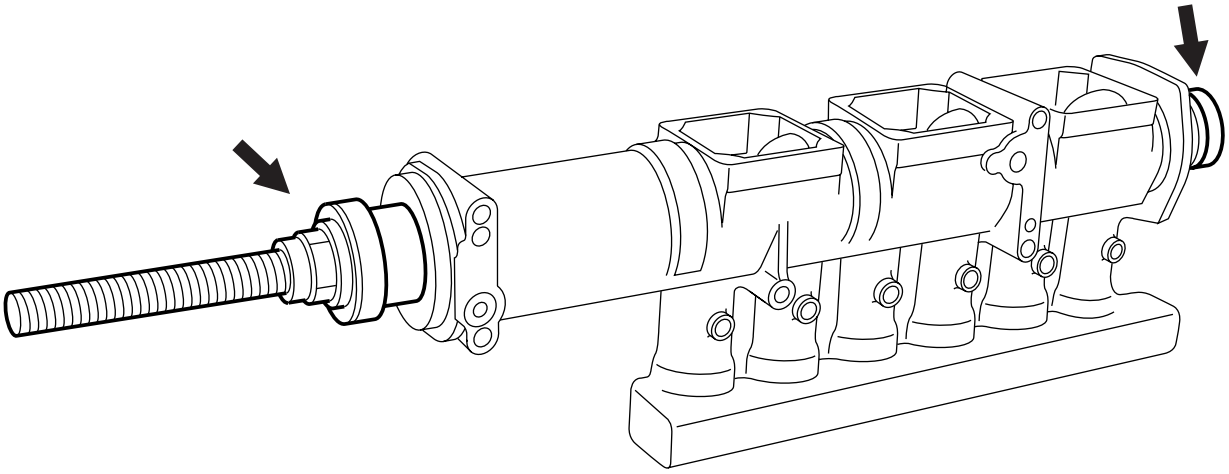
8. Remove the sealing plates and the gaskets.

9. Remove the pump camshaft by manoeuvring it vertically out of the pump housing.

10. Remove the slide bearings using the special tools (DAF no. 1329444) and (DAF no. 0535626).



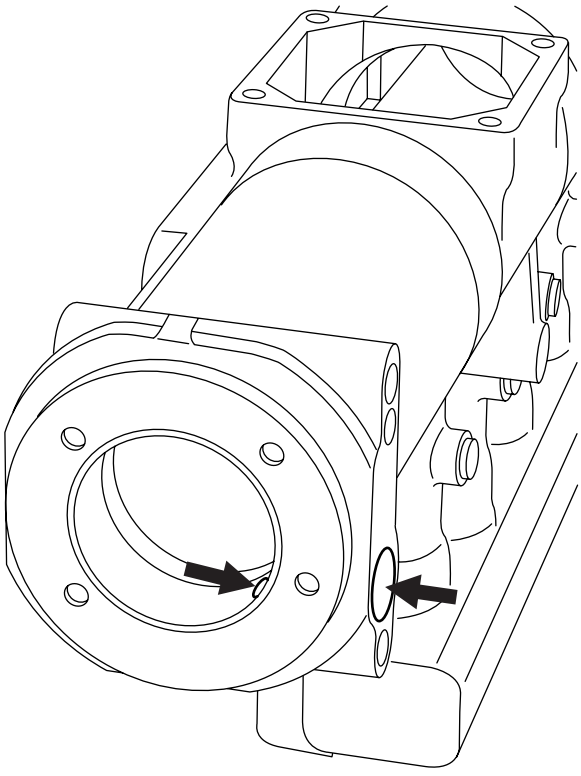
i400380



i400378

Assembling the pump housing

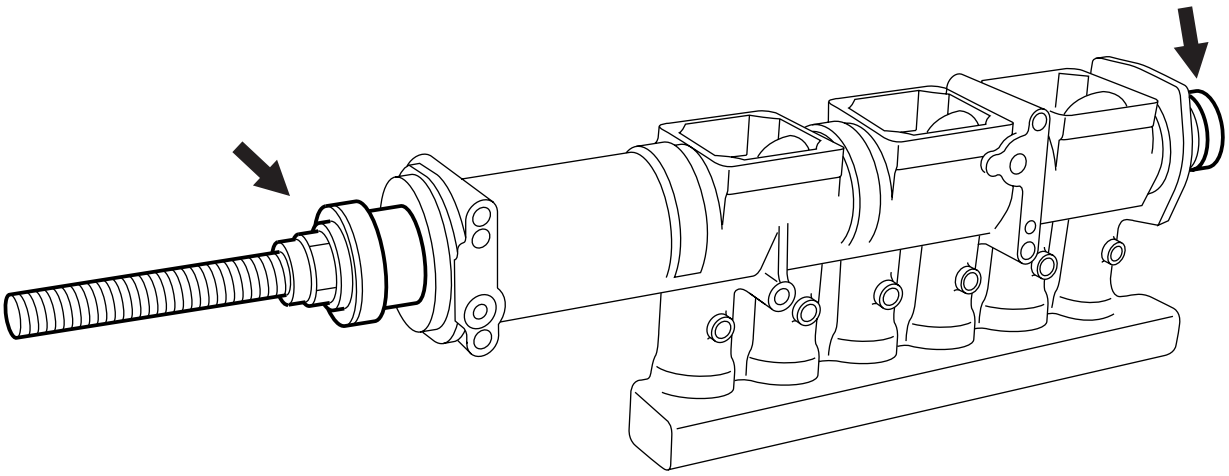
When fitting the front bearing shell it is important that the oil bore in the bearing housing aligns with the hole in the slide bearing.



i400382

8

© 200324



i400378

1. Use the special tools (DAF no. 1329444) and (DAF no. 0535626) to fit the bearing shells.

   Note:
   Before fitting the pump camshaft, oil the bearing journals lightly with lubricating oil. When fitting the bearing shells, take care not to damage them.

2. Fit the pump camshaft by lowering it vertically into the pump housing.

3. Clean the gaskets if necessary. Fit the gaskets and sealing plates and tighten the bolts to the specified torque. See "Technical data".

   Note:
   When fitting the locking plate, make sure it does not stick in the pump camshaft groove.

4. Fit the locking plate of the pump camshaft and the bolts, tightening them to the specified torque. See "Technical data".

5. Fit the pulse disc and tighten the bolts to the specified torque. See "Technical data".

6. If necessary, clean the groove in which the O-ring is fitted and apply a thin layer of lubricating oil.

7. Fit the O-ring.

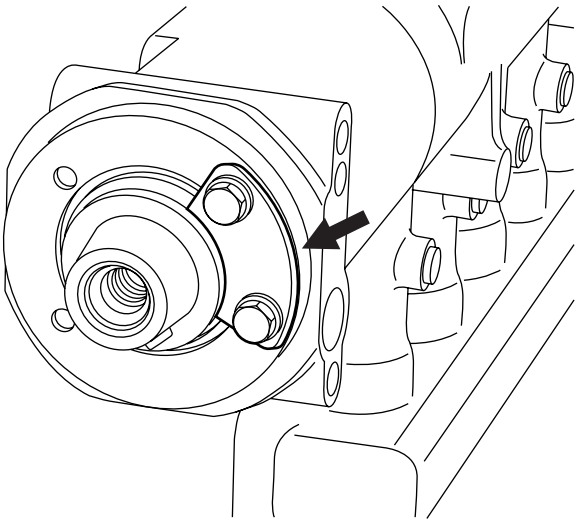
8. Fit the cover and tighten the bolts to the specified torque. See "Technical data".

9. Fit the fuel lift pump. See "Removal and installation".

10. Apply a thin layer of lubricating oil to the tappet rollers.

11. Fit the tappet rollers.

12. Fit the pump units. See "Removal and installation".



i400380

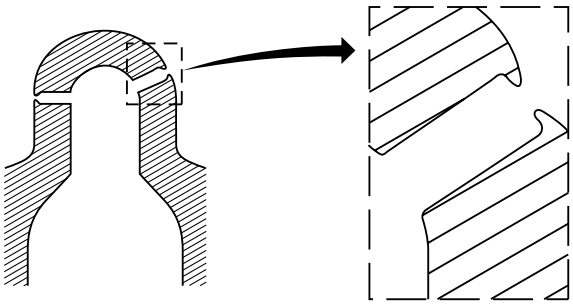
© 200324

6. CLEANING

6.1 CLEANING, INJECTOR

The injector body (nozzle) must never be cleaned with copper or steel wire brush. When cleaning the exterior of the injector nozzle, do not pass the brush over the injector nozzles. If this happens, the nozzle must be replaced.

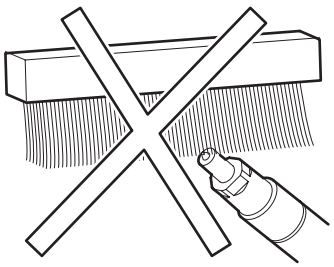
Injector nozzles
The use of steel or copper brushes can cause deformation of the injector nozzles with the result that the fuel is not injected in the corrrect way and the amount of fuel injected is affected.
Such deformation cannot be detected by carrying out the normal injector test.

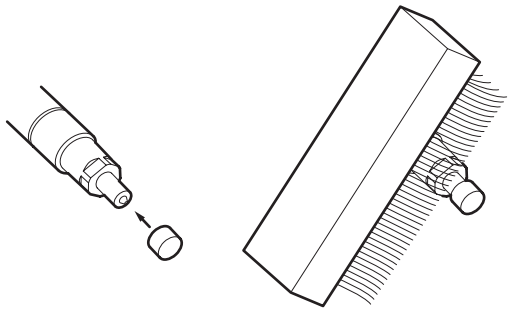


M2 00 040

The injector nozzles must not be cleaned (with a needle).

Nozzle
Before cleaning the nozzle, cover the injector nozzles and only clean the nozzle with the brass hand brush in the injector cleaning set (DAF no. 1329371).



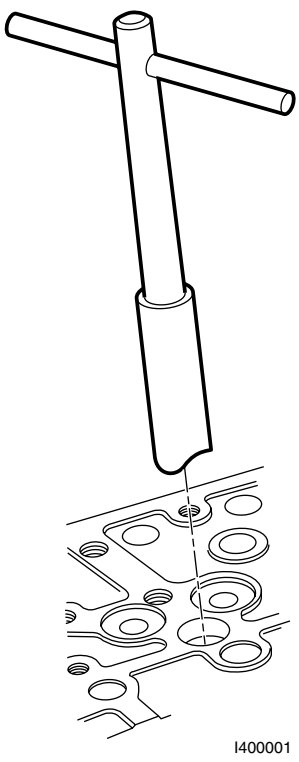


i 400413

8

6.2 CLEANING, INJECTOR SLEEVE

1. Remove the injector. See "Removal and installation".
2. Remove any copper washer left behind using the special tool (DAF no. 1240074).
3. Clean the injector sleeve using the special tool (DAF no. 1240074).
4. Clean the injector sleeve with compressed air.
5. Fit the injector. See "Removal and installation".


I400001

8

© 200324

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of components	2-1	200324
2.2	System description, turbocharger	2-3	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspecting and adjusting turbocharger wastegate	3-1	200324
3.2	Checking exhaust gas back pressure	3-2	200324
3.3	Inspection and pressure testing, air inlet system	3-3	200324
3.4	Checking inlet underpressure	3-4	200324
3.5	Checking the glow plug	3-4	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation, turbocharger	4-1	200324
4.2	Removal and installation of air cooler	4-3	200324
4.3	Removal and installation, air filter element	4-6	200324
4.4	Removal and installation, glow plug	4-7	200324
5.	**CLEANING**	5-1	200324
5.1	Cleaning the exterior of radiator/air cooler	5-1	200324
5.2	Cleaning, air filter element	5-2	200324

9

9

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

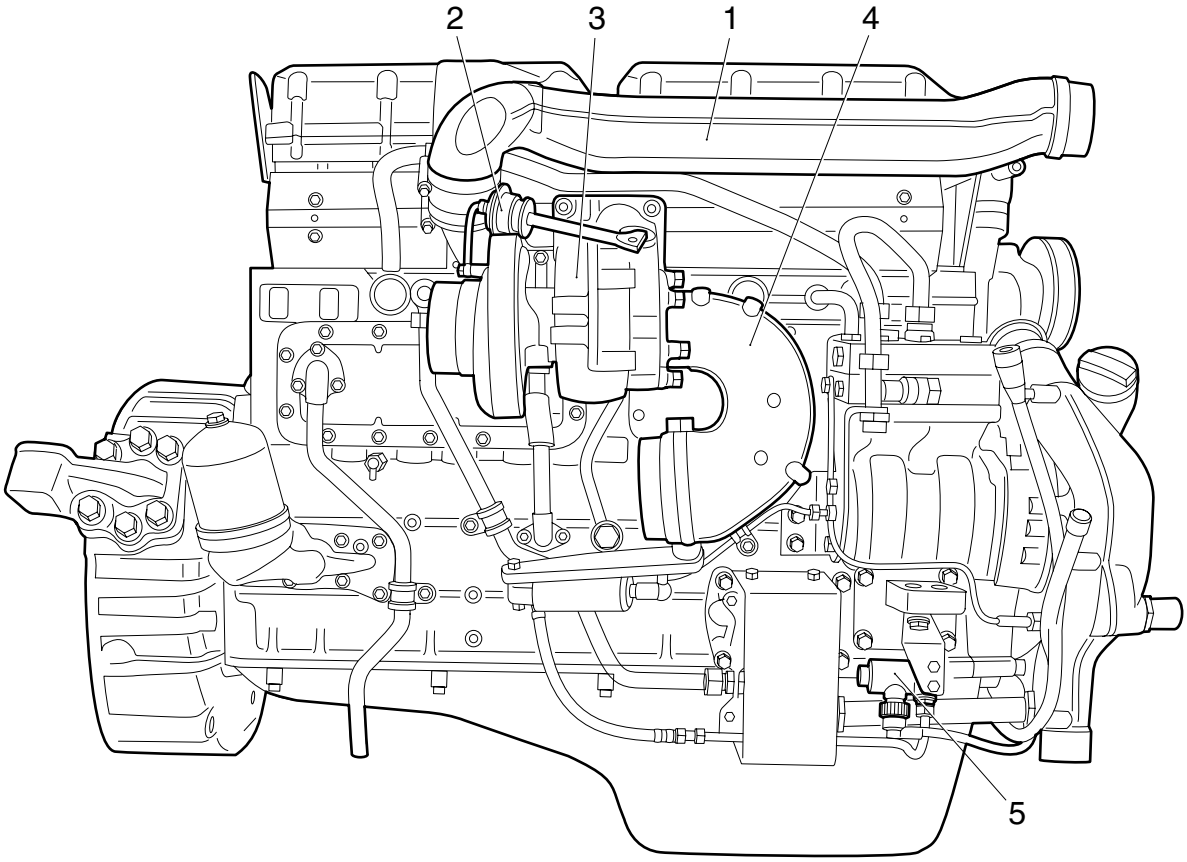
Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

© 200324

2. GENERAL

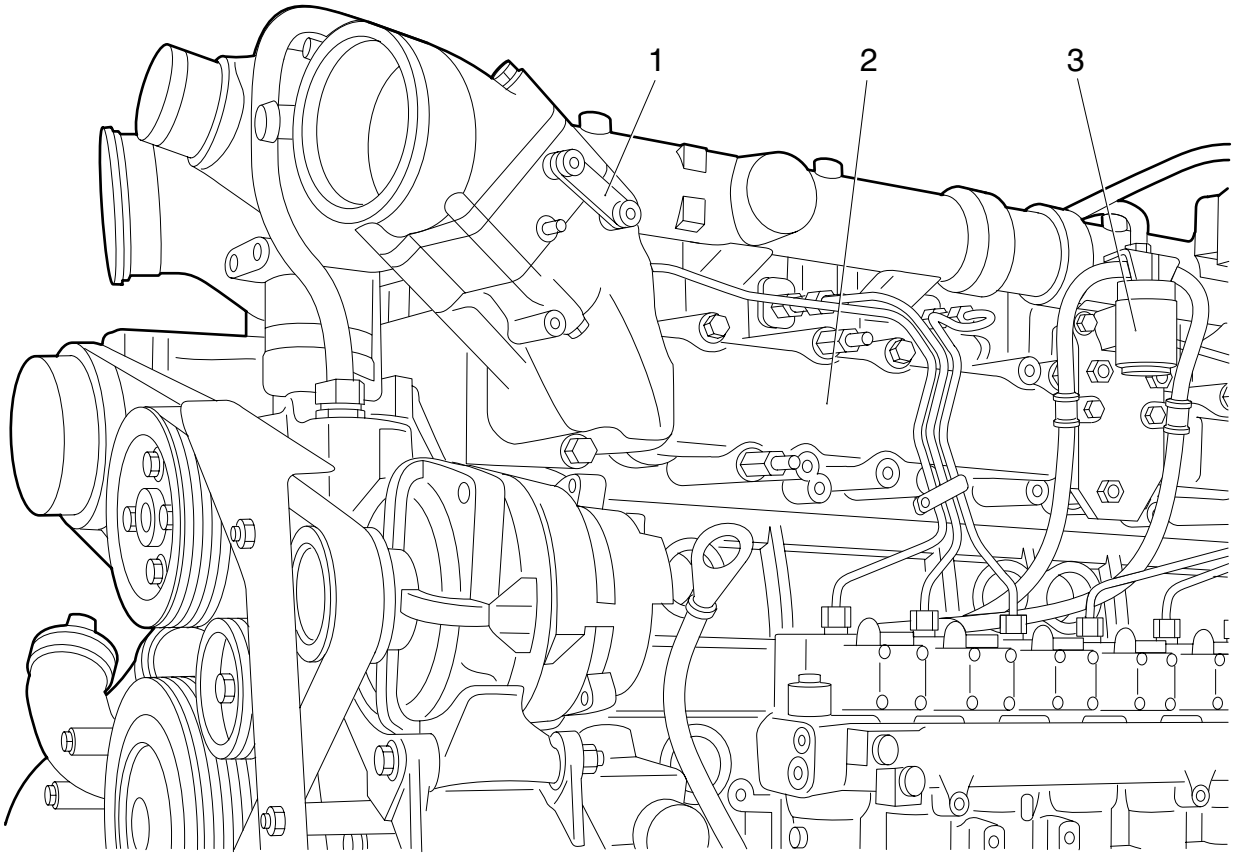
2.1 LOCATION OF COMPONENTS



I400531

1. Air intake pipe
2. Wastegate diaphragm
3. Turbocharger
4. Exhaust elbow with integrated butterfly valve
5. Exhaust brake valve

9

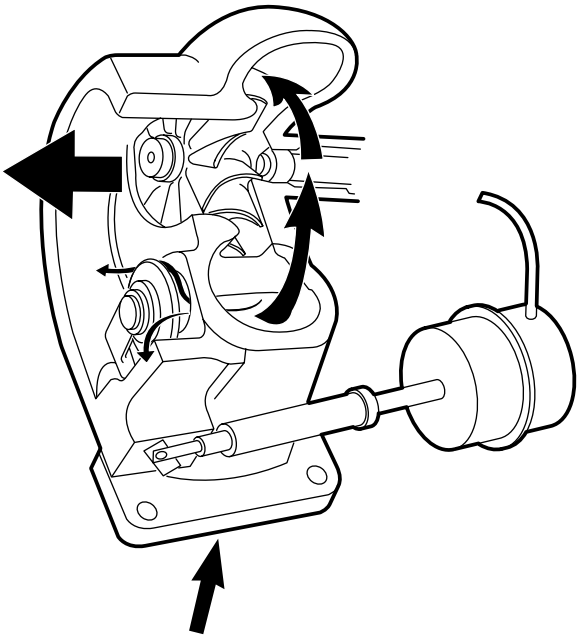


1. Glow plug
2. Inlet manifold
3. Glow plug relay

© 200324

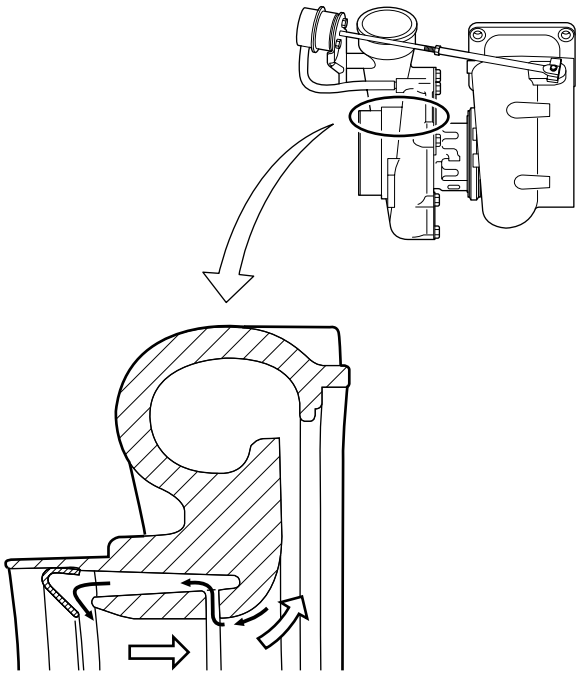
2.2 SYSTEM DESCRIPTION, TURBOCHARGER

Wastegate
To make the engine more responsive at lower engine speeds, a turbocharger is used that produces a better charge ratio at these speeds. Without provision having been made for this, the boost pressure yielded by this turbocharger would be too high at maximum engine speeds. Use of a wastegate prevents this.
The turbocharger's compressor housing has an air coupling connected to a diaphragm. The boost pressure yielded by the turbocharger operates the diaphragm and the control rod connected to it. The control rod operates a valve in the turbine housing.
The valve in the turbine housing is opened when the maximum pre-set pressure has been reached.
When the valve is opened, some of the exhaust gases will be discharged directly to the exhaust pipe rather than being used to propel the turbocharger's turbine wheel.



i400309

Compression housing by-pass
At higher boost pressures, the turbocharger compressor tends to allow this pressure to return to the intake underpressure area. To prevent this, the turbocharger's compression housing has been adapted.
This adaptation consists of bypass ducts and a stop plate.
Boost pressure attempting to return to the intake area will do so at the outer circumference of the compression housing.
The compression housing has been fitted with an air slot to force this pressure to flow back through special air ducts on the outside until it is arrested by the stop plate.



i 400212

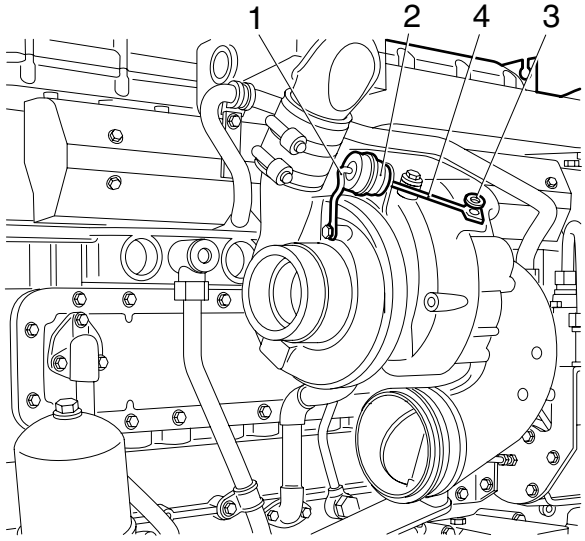
9

© 200324

3. INSPECTION AND ADJUSTMENT

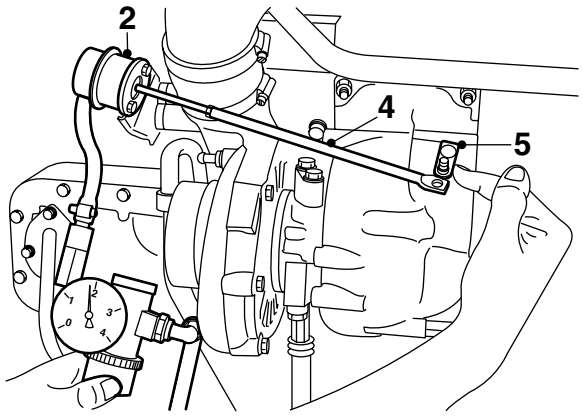
3.1 INSPECTING AND ADJUSTING TURBOCHARGER WASTEGATE

1. Remove the heat shield from the turbocharger.
2. Remove the air supply connector (1) from the diaphragm housing (2).
3. Remove the retaining clip (3) and remove the control rod (4) from the wastegate lever.



I400532

4. Using a reducer valve, apply the specified adjusting pressure to the connection with the diaphragm housing (see "Technical data").
5. Push the wastegate lever (5) fully to the left to close the wastegate valve.
6. Adjust the length of the control rod (4), making sure it fits exactly onto the lever at the set pressure.
7. Inspect the adjustment of the wastegate using the specified pressure. See "Technical data".
8. Fit the retaining clip (3).



i 400214

9

3.2 CHECKING EXHAUST GAS BACK PRESSURE

Checking exhaust gas back pressure

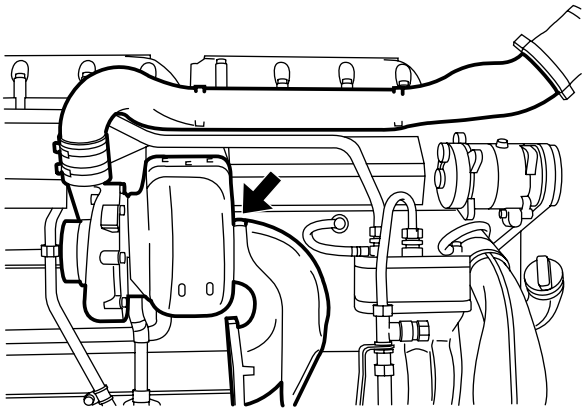
1. Remove the plug from the exhaust bracket and install a suitable coupling with a pipe. The first part of the pipe must be made of metal, to withstand the high temperatures.

2. Connect a pressure gauge to the pipe, with a range of at least 0.1 - 0.2 bar (10 - 20 kPa).

   Note:
   Use an attenuated gauge to prevent excessive shaking of the gauge needle.

   The engine brake must not be used during measurements.
   This is to protect the pressure gauge.

3. Measure the exhaust gas back pressure at full-load engine speed and compare the measurement to the specified value; see "Technical data".



i 400180

9

3.3 INSPECTION AND PRESSURE TESTING, AIR INLET SYSTEM

When pressure testing the air intake system, the plugs may spring off if they are not properly secured.

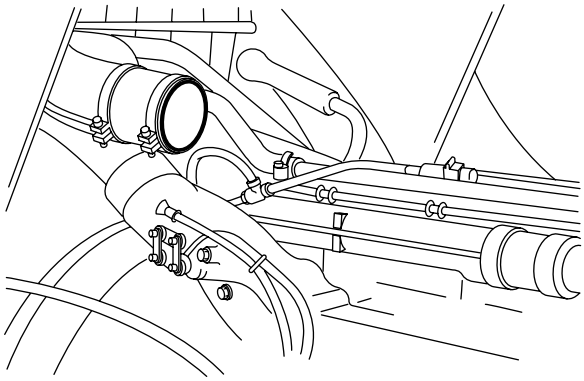
Check the condition and mounting of the air inlet channels/pipes of the air intake system.

In case of doubt as to the proper sealing of the air intake system, which is indicated by the following:

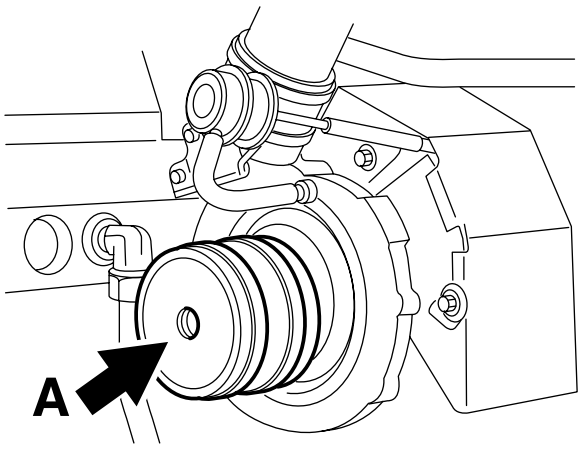
1. loss of power
2. high fuel consumption
3. unusual noises

carry out a pressure test to check the air inlet system for leaks.

1. Remove the front engine encapsulation.
2. Remove the air inlet hose between the air cooler and the inlet manifold.
3. Connect the inlet pipe, fitted with the special tool (DAF no. 0694831) slightly turned, to the air cooler.
4. Remove the air intake pipe between the air filter housing and the turbocharger intake port.
5. Install special tools (DAF no. 1329310) and (DAF no. 1329311) on the turbocharger intake port.
6. Connect an air pipe with reducer valve to the sealing plug (A), and charge the system to approx. 1 bar.
7. Use a soapy solution to check the whole inlet system for air leaks. Also check whether the pressure gauge of the reducer valve drops.



i 400203

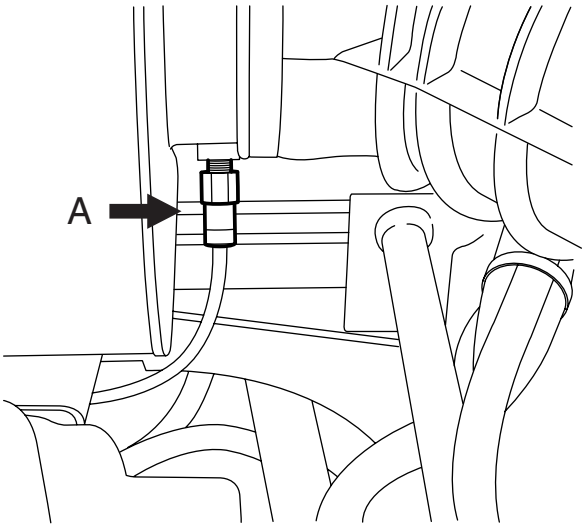


i 400204

9

3.4 CHECKING INLET UNDERPRESSURE

1. Remove the underpressure indicator connection (A) from the air intake pipe between the air filter housing and turbocharger.
2. Connect a pressure gauge with a maximum rating of -100 mbar (-10 kPa) to the connection of the underpressure indicator.
3. Measure the inlet underpressure at full-load engine speed and compare the measurement to the specified value. See "Technical data".



i400377

3.5 CHECKING THE GLOW PLUG

Checking the glow plug

1. Remove the electrical connections on the glow plug.
2. Using a multimeter, determine the resistance of the glow plug. See "Technical data".
3. Remove the connecting hose between the inlet pipe and the air cooler.
4. Check whether the glow plug is damaged.

9

© 200324

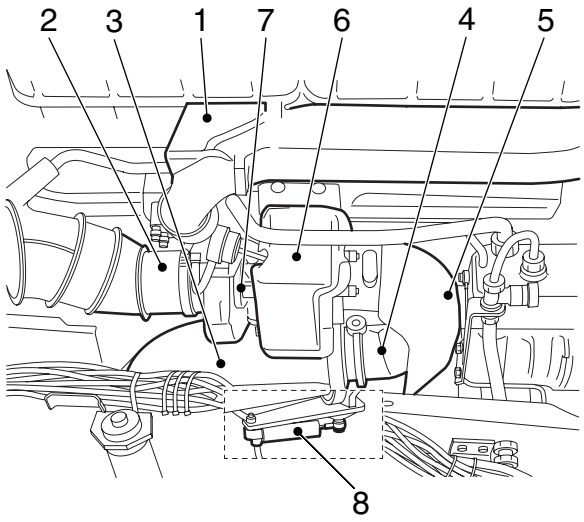
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, TURBOCHARGER

If parts are missing or broken when the turbocharger is removed and/or lubricating oil has entered the inlet system, the inlet and exhaust systems must be checked and cleaned thoroughly in order to prevent serious damage to the engine.

Removing the turbocharger

1. Remove the noise insulation on the right-hand side of the engine.
2. Remove the inlet air pipe (1) and the flexible pipe (2).
3. Remove the turbocharger heat shield (6) and the exhaust brake heat shield (5).
4. Remove the turbocharger oil supply and discharge pipes from the engine block.
5. Disconnect the air connection from the exhaust brake cylinder (8).
6. Remove the exhaust brake (4) if necessary. (This can also be done after the turbocharger, including exhaust brake, has been rremoved from the exhaust manifold.) If the exhaust brake stays attached, the clamping strip of the exhaust pipe (3) needs to be loosened.
7. Remove the turbocharger (7) from the exhaust manifold flange.



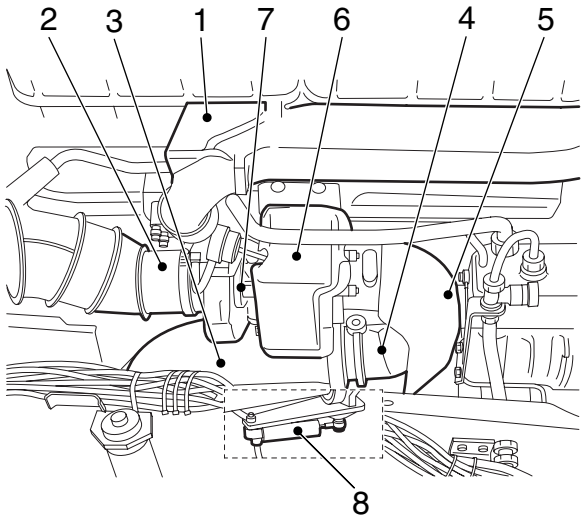
Installing the turbocharger

Before installing the turbocharger, check the following:

- The turbocharger shaft must rotate freely.
- The turbocharger shaft must not run out of true.
- The turbocharger shaft must have some radial clearance.
- If applicable: movement of the wastegate.
- Clean the sealing surfaces.
- Apply a layer of Copaslip to the exhaust manifold studs.
- Always use new gaskets during installation.

9

1. Fit (if removed) the exhaust brake (4).
2. Install the turbocharger (7) on the exhaust manifold flange and tighten the attachment nuts to the specified torque. See "Technical data". If necessary, turn the two halves of the housing so that the oil and air pipes can be connected free of stress.
3. Attach the exhaust pipe (3) to the clamping strip (4) on the exhaust brake.
4. Fasten the air pipe of the exhaust brake cylinder (8).
5. Fit the oil discharge pipe.
6. Pour clean engine oil into the oil supply of the turbocharger and fit the oil supply pipe.
7. Fit the air inlet ipie (1) and the flexible pipe (2).
8. Install the heat shields (6 and 5) and tighten the attachment bolts to the specified torque. See "Technical data".
9. Fit the sealing plate.
10. **Always** check the setting of the wastegate, see "Inspection and adjustment".



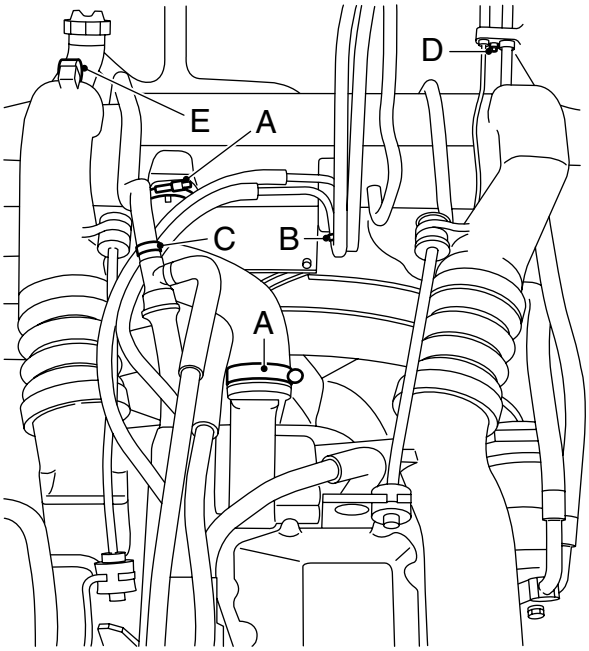
i400671

4.2 REMOVAL AND INSTALLATION OF AIR COOLER

Note:
The removal and installation procedure of the air cooler allows for the presence of an air-conditioning unit.
If such a unit is not present, the sections concerned can be skipped. Draining and filling of the air-conditioning system must only take place if the workshop is certified to do this.

Removing the air cooler

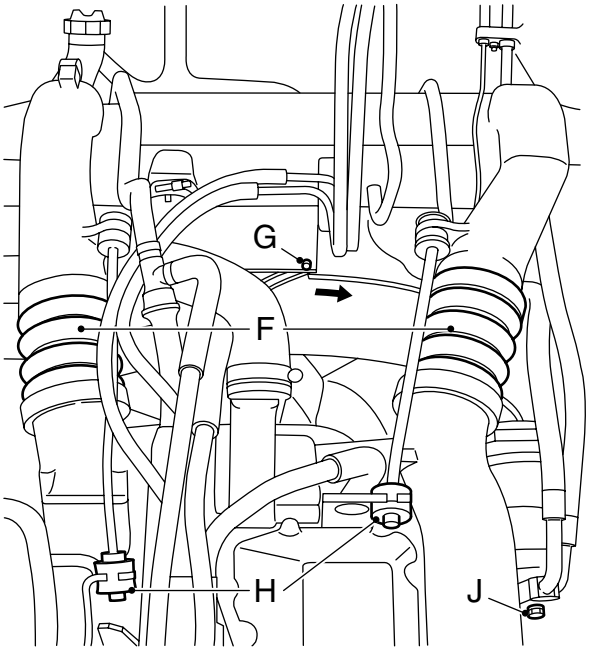
1. Disconnect the earth lead from the battery terminal.
2. Drain the engine coolant from the radiator.
3. Disconnect the pipe from the bottom of the radiator.
4. Carefully disconnect the air-conditioning compressor and condenser and hang them to one side (the system must not be opened).
5. Disconnect the oil filler pipe and hang it to one side.
6. Disconnect all coolant hoses (A, B and C) connected to the radiator.



M201031

9

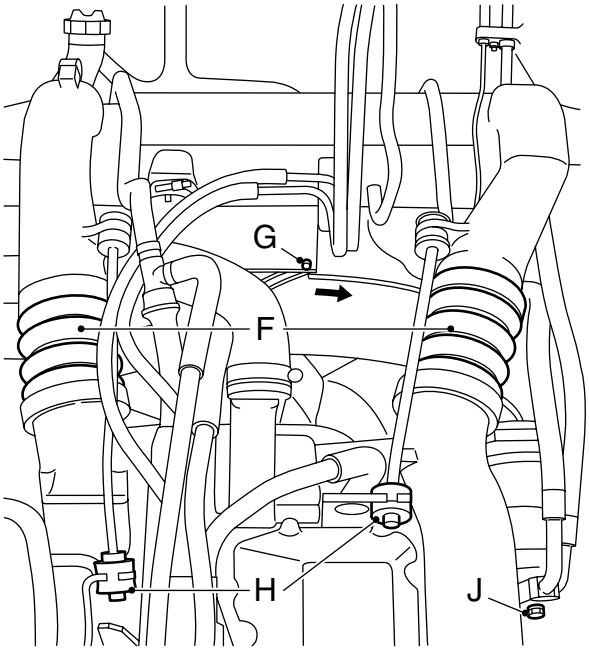
7. Remove the left push/pull rod (H).
8. Remove the rubber air inlet hoses (F).
9. Remove the retaining screw (G) and turn the wind tunnel collar into the wind tunnel.
10. Remove the attachment nuts on the bottom of the radiator and remove the assembly.



M201032

Installing the air cooler

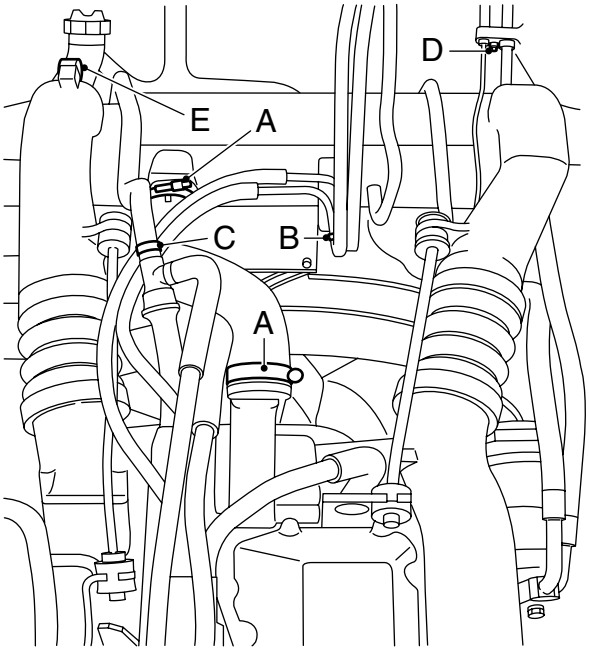
1. Position the radiator assembly, carefully lower it into the chassis and fasten the radiator.
2. Turn the wind tunnel collar back and position the retaining screw (G).
3. Fit the rubber air inlet hoses (F).
4. Fit the push/pull rods (H).



M201032

© 200324

5. Fit the coolant hoses (A, B and C).
6. Tighten the oil filler pipe.
7. Fit the air conditioning unit.
8. Fasten the pipe on the bottom of the radiator.
9. Fill the cooling system. See "Draining and filling".
10. Start the engine and check for water leaks.

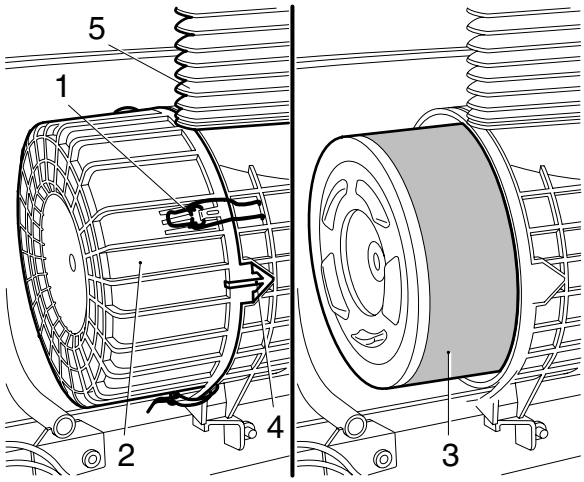


M201031

4.3 REMOVAL AND INSTALLATION, AIR FILTER ELEMENT

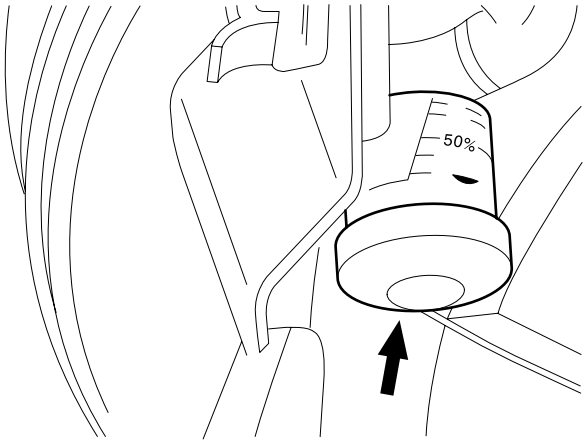
Removing the air filter element

1. Loosen the brackets (1) of the air filter cover (2).
2. Remove the air filter cover (2).
3. Remove the air filter element (3).
4. Clean the inside of the air filter housing and the air filter cover.



i400443

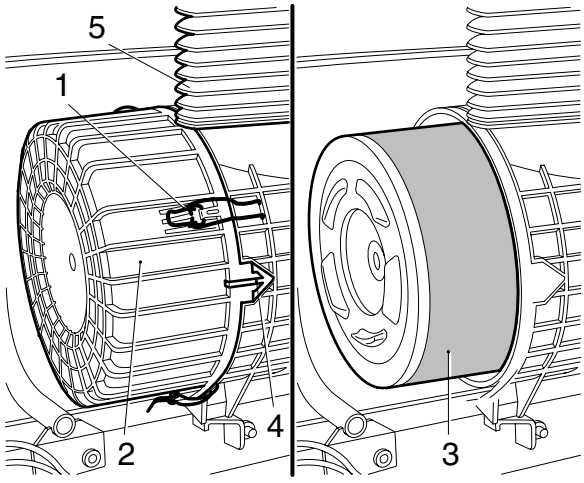
5. When replacing the air filter element, reset the air filter indicator, if fitted, by pressing the button on the top of the indicator.



V300386

Installing the air filter element

1. Fit the air filter element (3) to the air filter housing.
2. Fit the air filter cover. Note the position of the arrow (4) on the air filter cover (2)
3. Fit the clamp brackets (1) around the air filter.
4. Check that the flexible sealing bellows (5) on the air intake is not damaged. Replace if necessary.



i400443

4.4 REMOVAL AND INSTALLATION, GLOW PLUG

Removing the glow plug

1. Disconnect the earth lead from the battery terminal.
2. Remove the air inlet hose.
3. Remove the glow plug
4. Inspect the glow plug for damage. See "Inspection and adjustment".

Installing the glow plug

1. Install the glow plug.
   Clean the contact surface between inlet manifold and glow plug to ensure that the glow plug is properly earthed on the inlet manifold.
2. Fit the air inlet hose.
3. Fit the earth cable.

© 200324

5. CLEANING

5.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER

Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

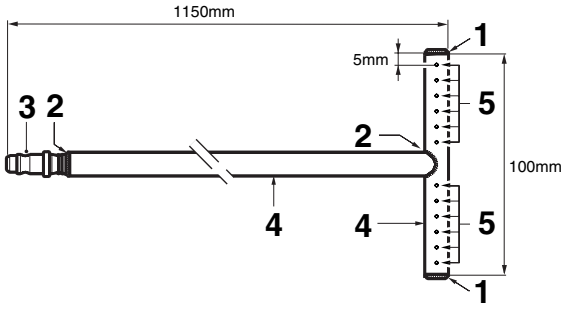
1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.
This tool can be made in your own workshop. It cannot be ordered from DAF.

Key to drawing:

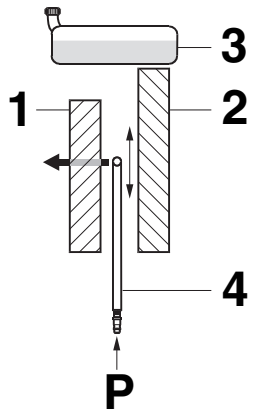
1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, ø 10 mm
5. 6 x ø 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side.



M2108

Note:
Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

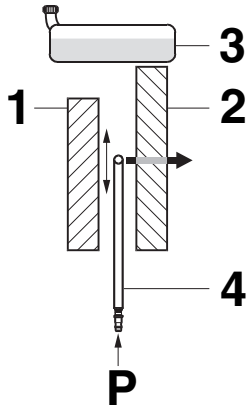
1. From below, insert the radiator cleaner (4) between the air cooler (1) and radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.



M2109

9

3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).
4. Fit the wire mesh.
5. Install the lower grille.

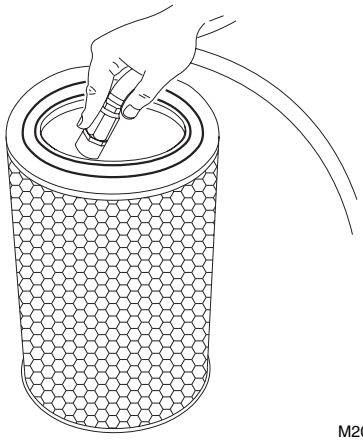


M2110

5.2 CLEANING, AIR FILTER ELEMENT

Inhalation of dust may have serious consequences for your health. Use mouth and eye protection.

1. Remove the air filter element. See "Removal and installation".
2. Check the air filter element for damage. If the air filter element or its sealing rings are damaged, the air filter element must be replaced.
3. Knock out the air filter element.
4. Blow-clean the air filter element by blowing pressurised air through from the inside, using a maximum pressure of approx. 1.5 bar.
5. Fit the air filter element. See "Removal and installation".


M2009

CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200324
1.1	Safety instructions	1-1	200324
2.	**GENERAL**	2-1	200324
2.1	Location of DEB components	2-1	200324
2.2	Location of components, DEB housing	2-2	200324
2.3	Location of exhaust brake components	2-4	200324
2.4	System description, engine brake, general	2-5	200324
2.5	System description, DEB	2-5	200324
2.6	System description, exhaust brake	2-15	200324
3.	**INSPECTION AND ADJUSTMENT**	3-1	200324
3.1	Inspection and adjustment, DEB clearance	3-1	200324
3.2	Functional check, DEB	3-2	200324
3.3	Inspection and adjustment, exhaust brake	3-4	200324
4.	**REMOVAL AND INSTALLATION**	4-1	200324
4.1	Removal and installation, DEB	4-1	200324
4.2	Removal and installation, DEB spring plate	4-3	200324
4.3	Removal and installation of exhaust brake	4-5	200324

10

10

© 200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel

Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape.
To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases
Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Exhaust gases contain carbon monoxide.
Carbon monoxide is a deadly colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

Moving parts
Remain at a safe distance from rotating and/or moving components.

Various fluids
Various oils and lubricants used on the vehicle may constitute a health hazard.
This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid.
So avoid inhaling and direct contact.

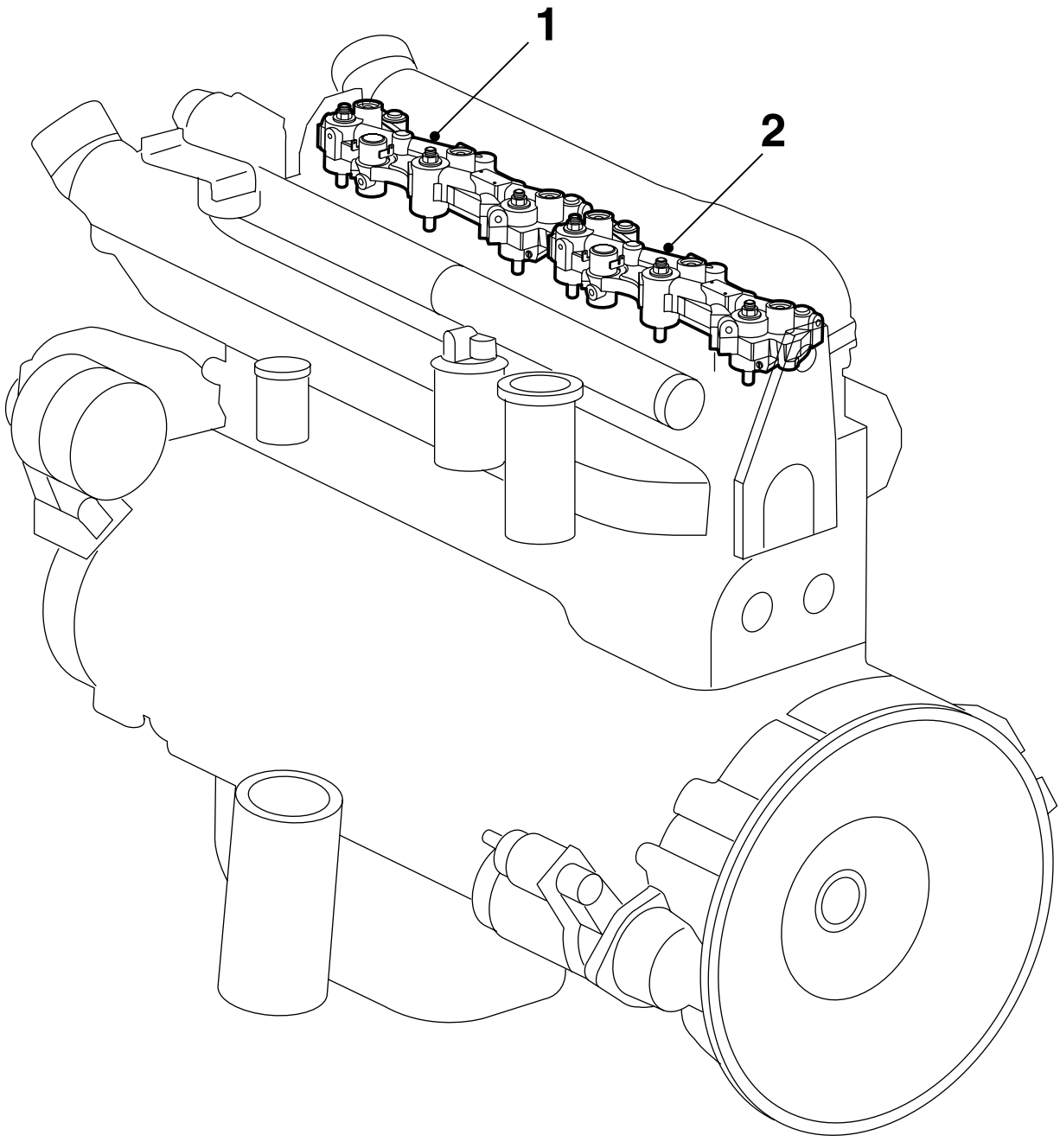
Electrical short-circuit
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

10

© 200324

2. GENERAL

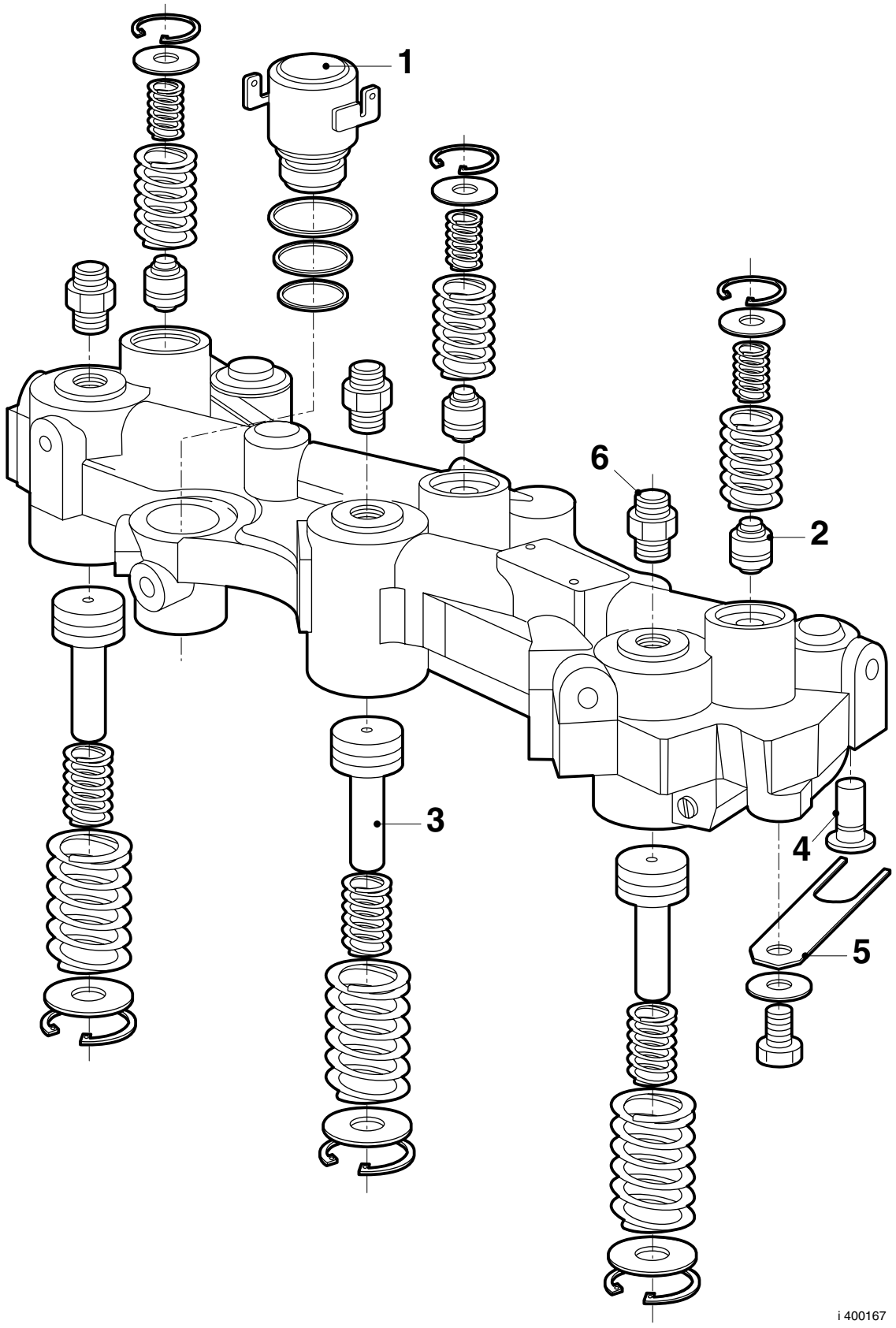
2.1 LOCATION OF DEB COMPONENTS



i 400389

1. DEB housing, cylinders 1 - 2 - 3
2. DEB housing, cylinders 4 - 5 - 6

2.2 LOCATION OF COMPONENTS, DEB HOUSING



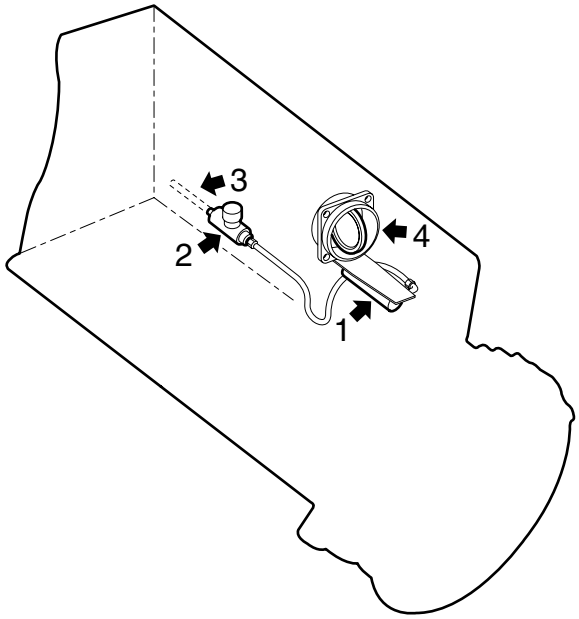
10

© 200324

1. Solenoid valve
2. Control valve
3. Operating piston
4. Main piston
5. Spring plate
6. Set screw

2.3 LOCATION OF EXHAUST BRAKE COMPONENTS

1. Operating cylinder, exhaust brake
2. Exhaust brake valve
3. Supply pressure
4. Butterfly valve



I400533

2.4 SYSTEM DESCRIPTION, ENGINE BRAKE, GENERAL

The collective designation 'engine brake' includes the engine brake (butterfly valve) and the DAF Engine Brake (DEB).

With the introduction of the DAF 12.6 litre engine, a new type of engine brake was introduced for DAF, which could also be applied to XE engines. This is the DAF Engine Brake or DEB for short.

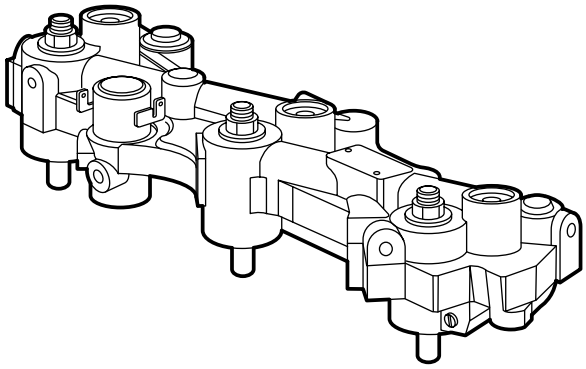
Every XE engine has a factory-fitted exhaust brake.
At the request of the customer, the DEB can be fitted at the factory or at a later date.

If the driver activates the engine brake by means of the engine brake control switch on the cab floor, both the exhaust brake and the DEB are engaged. Therefore, the DEB always works in conjunction with the exhaust brake.

As the UPEC electronic unit checks the activation of the engine brake, it will disengage the engine brake below a certain engine speed (see UPEC system manual).

2.5 SYSTEM DESCRIPTION, DEB

The DEB consists of two different housings, each cylinder head having its own DEB housing.
Each housing contains various valves, pistons, and a solenoid valve.
When the DEB is activated, fuel ceases to be injected and one exhaust valve will be opened hydraulically at the end of the compression stroke. This means that the compressed air can escape to the exhaust system, so that during the working stroke this pressure does not help the piston to fall.



i 400160

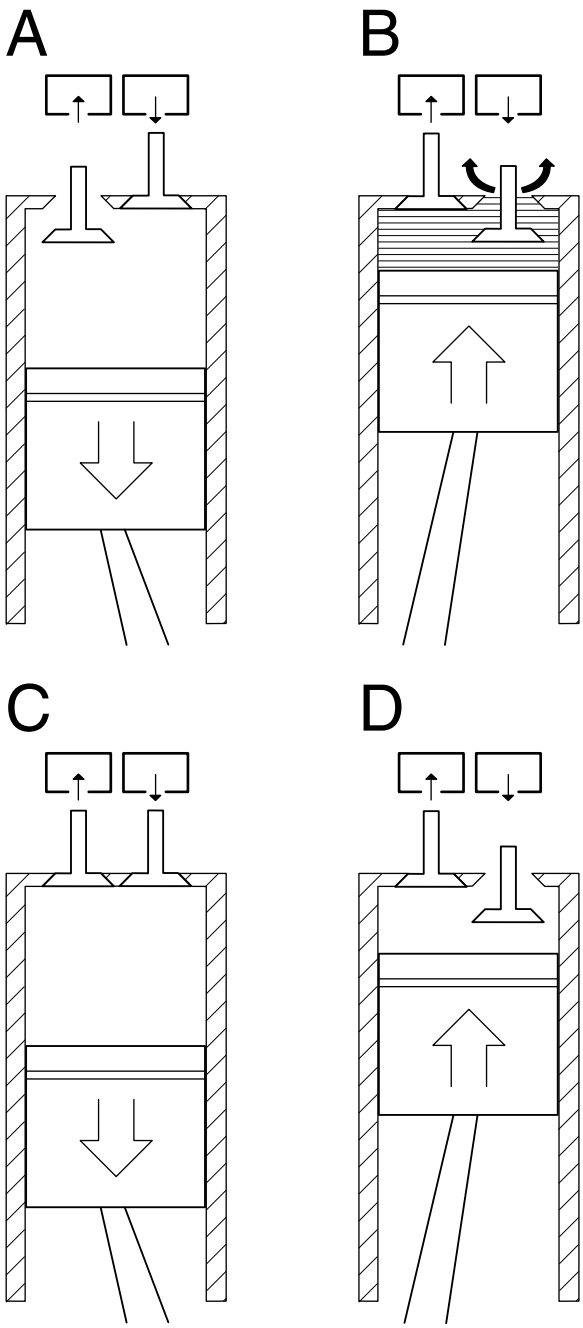
10

Position A: Induction stroke
The piston moves down and the cylinder is filled with clean air.

Position B: Compression stroke
The piston moves up and compresses the air in the cylinder, creating a braking force.
At the end of this stroke, one exhaust valve is opened briefly. The compressed air can now escape to the exhaust system. Otherwise this compressed air would press the piston down faster.
If the DEB has been activated, no fuel is injected and hence no combustion takes place.

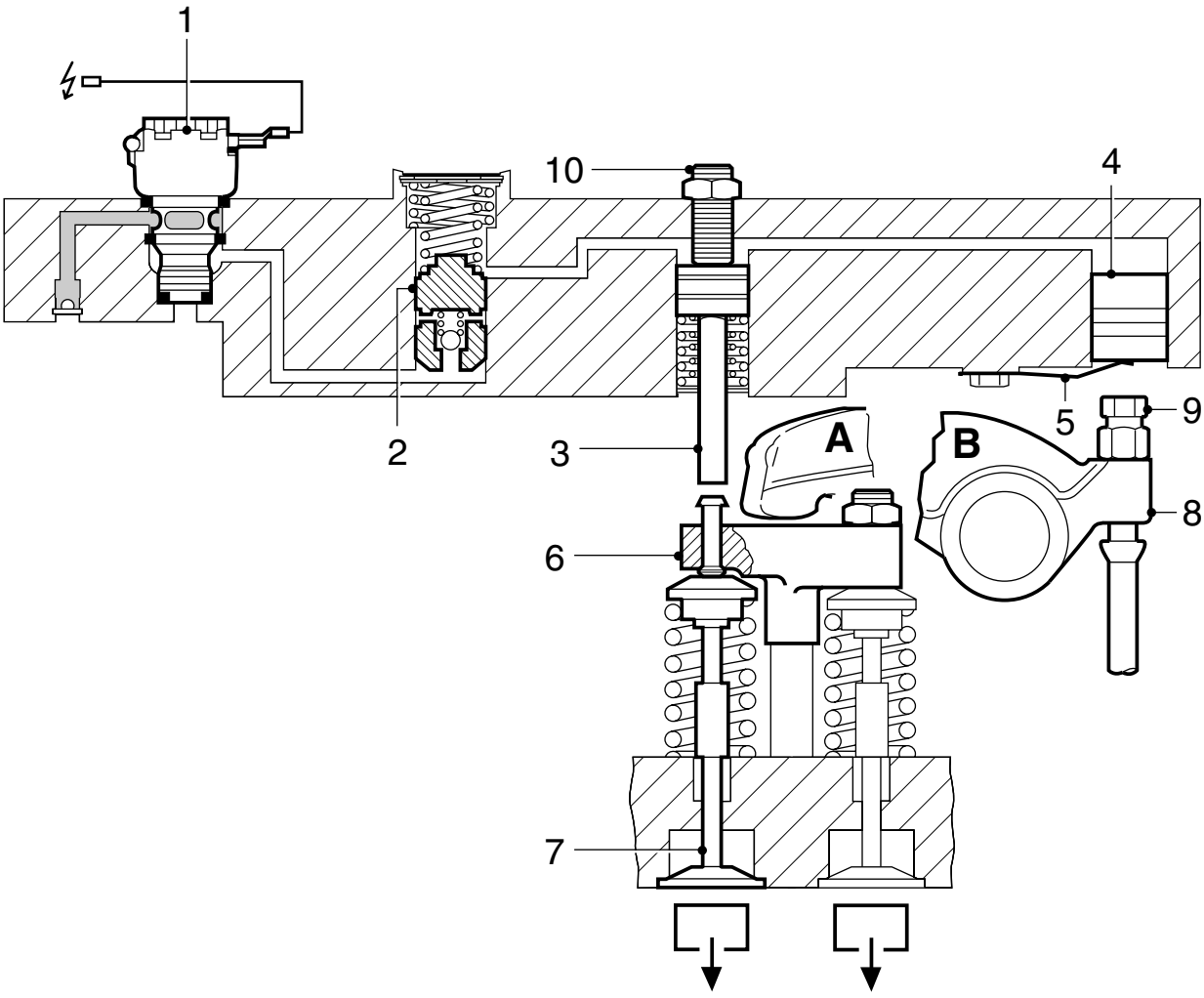
Position C: Power stroke
The piston moves down and the exhaust valve is closed.

Position D: Exhaust stroke
The piston moves up, as during a normal exhaust stroke.



10

DEB operation, hydraulic
DEB disengaged

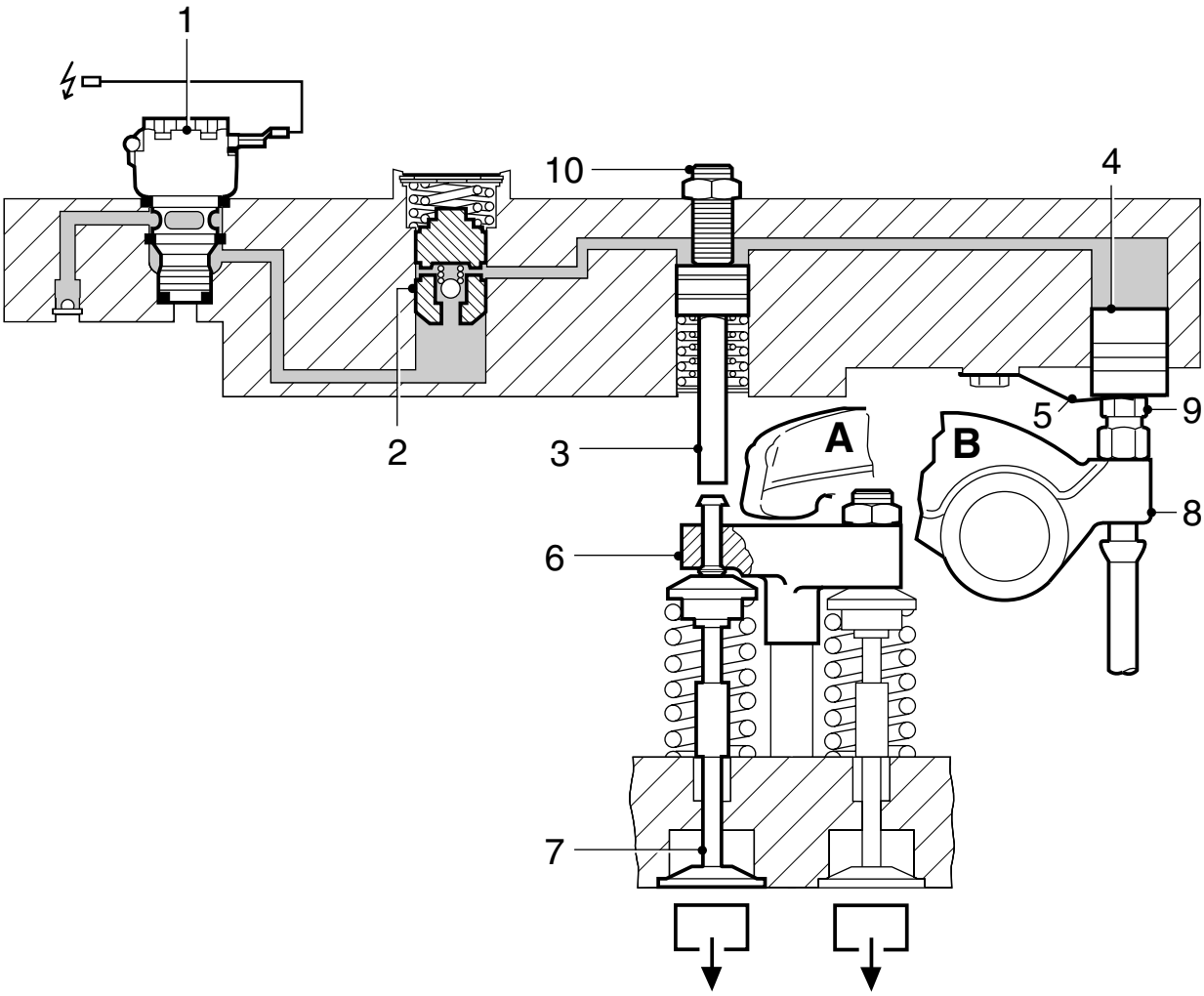


1. Solenoid valve
2. Control valve
3. Operating piston
4. Main piston
5. Spring plate
6. Bridge piece
7. Exhaust valve
8. Exhaust valve rocker
9. Valve clearance set screw
10. DEB set screw

Note:
Rockers A and B are not one and the same rocker (see "Hydraulic control of exhaust valves").
A. Exhaust valve rockers
B. Exhaust valve rockers

The solenoid valve (1) is not activated.
Lubricating oil cannot pass to the hydraulic part of the DEB.
In addition, a spring plate (5) ensures that the main piston (4) remains in the top position.

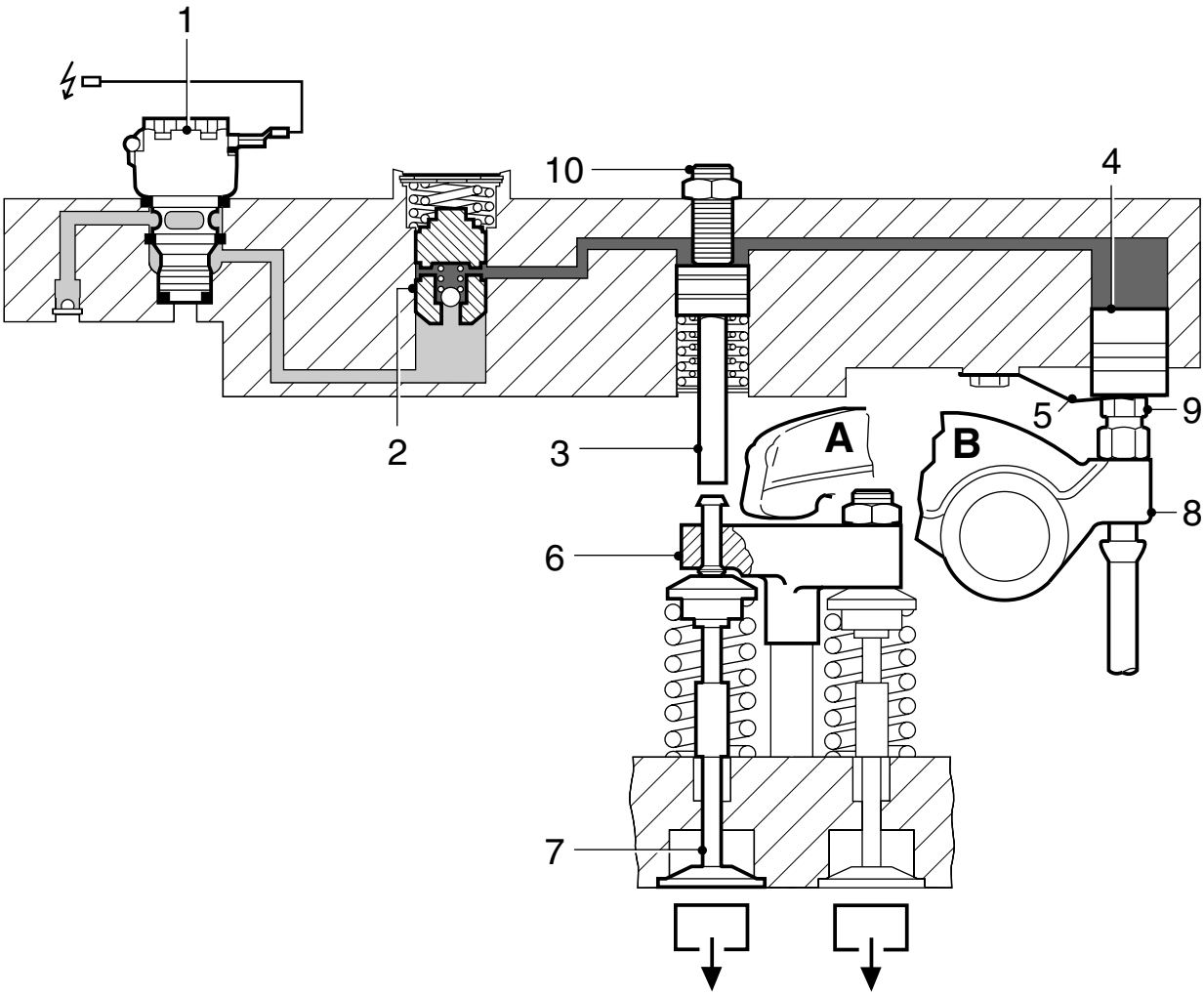
DEB engaged



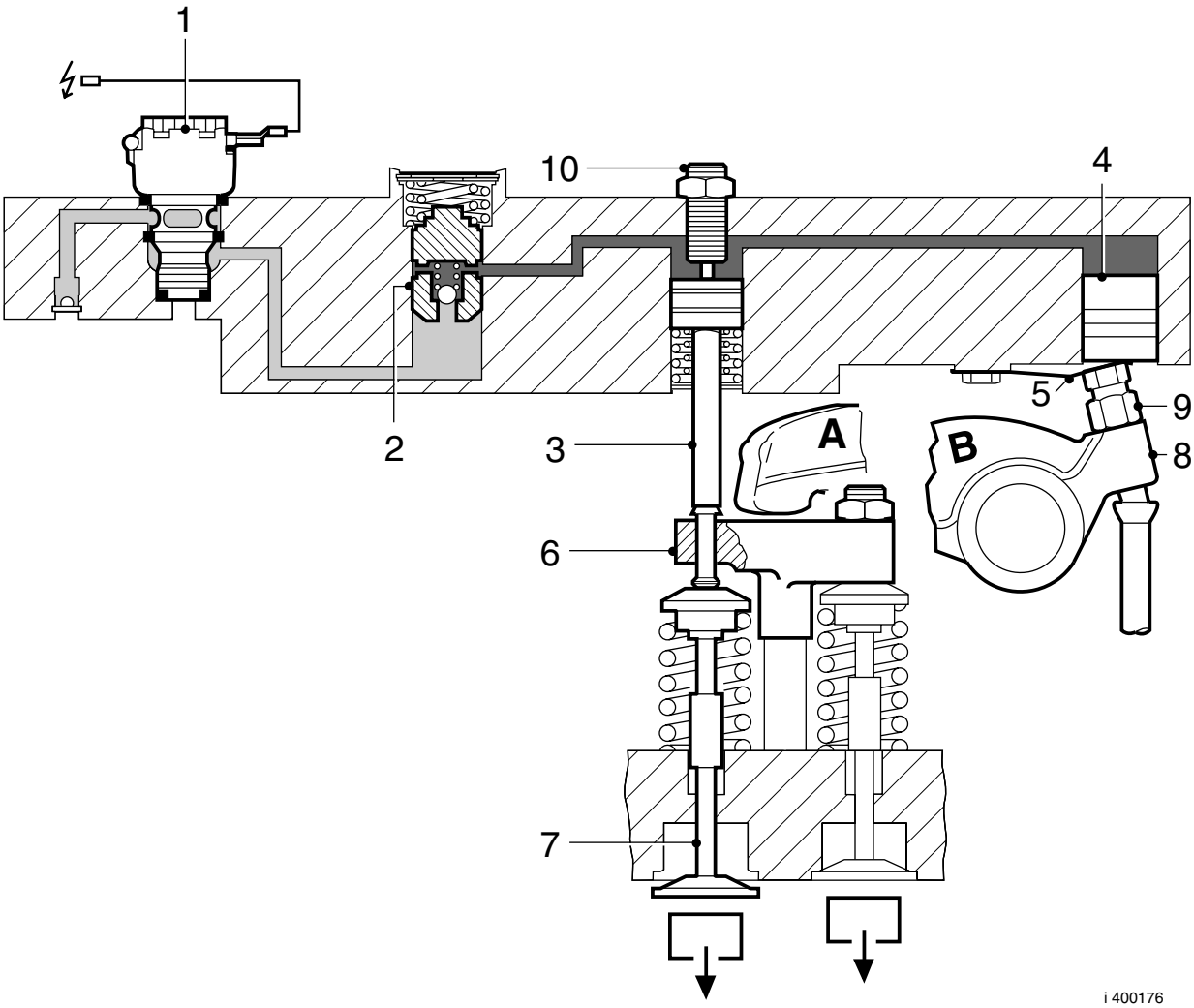
i 400174

The solenoid valve (1) is activated. Lubricating oil can pass to the hydraulic part of the DEB.
The pressure of the lubricating oil, at least 1.5 bar, moves the control valve (2) upwards against the spring pressure and lifts the ball from its seat.
The high-pressure area of the DEB is now filled with lubricating oil.
The oil causes the main piston (4) to move down, until it rests on the set screw (9) of the rocker (8).

10



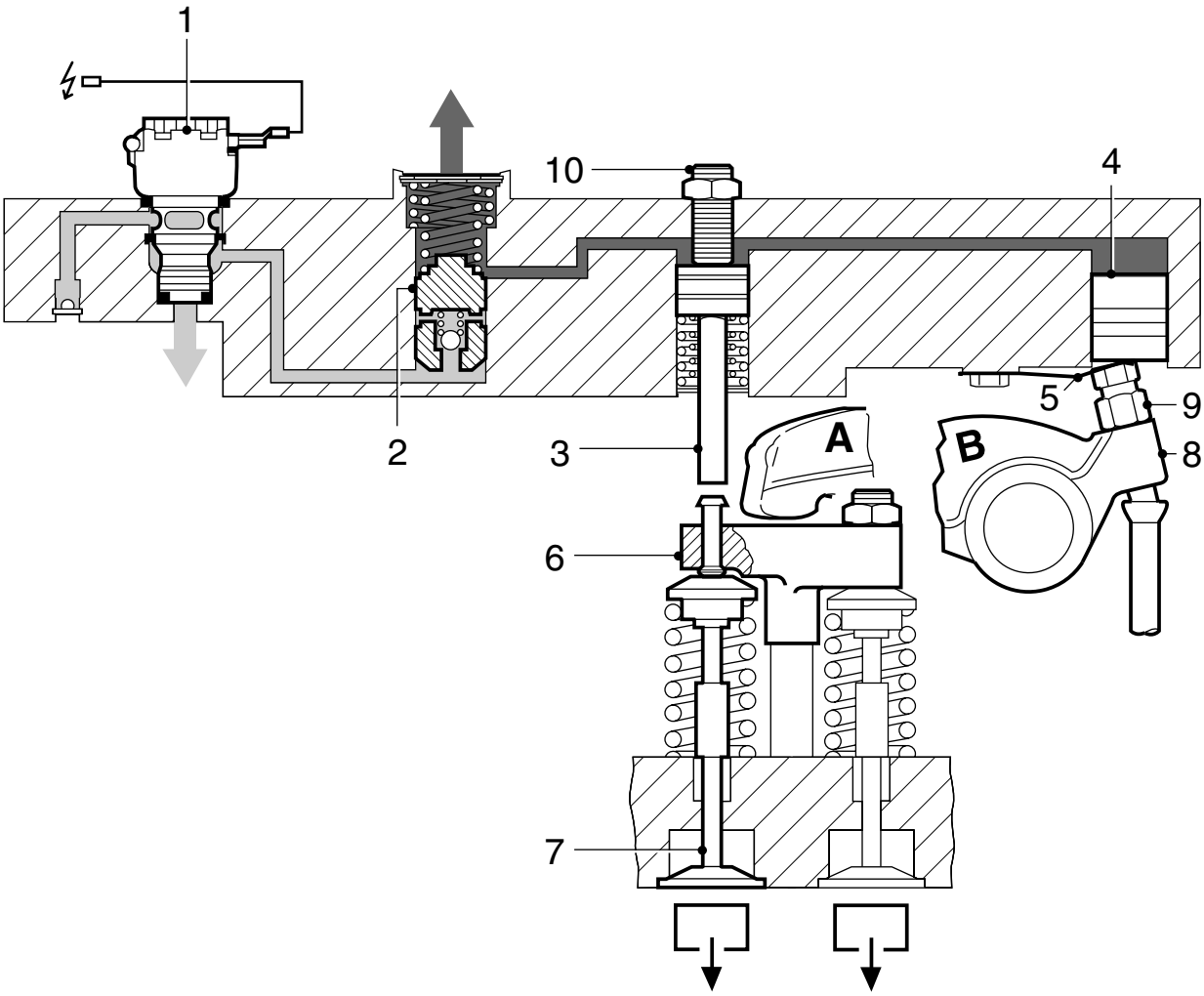
During the next upward movement of the rocker (8), the main piston (4) will be moved upwards. The main piston (4) begins to build up pressure, causing the ball in the control valve (2) to close off the oil supply.



If the main piston (4) continues to move up, this movement is transferred hydraulically to the operating piston (3).
The operating piston (3) moves downwards against the spring pressure, opening one exhaust valve.
In the case of loss of oil during operation, this will automatically be compensated for by the control valve (2).

10

Disengaging the DEB



The solenoid valve (1) is no longer activated. The spring pressure moves the control valve (2) downwards, as the oil pressure under the control valve (2) flows back into the engine through a hole in the solenoid valve (1).
The oil from the high-pressure area of the DEB can now escape through a cleared opening above the control valve (2).
This is effected by the main piston (4) being moved up by the rocker.
The spring plate (5) holds the main piston (4) in its top position.

Hydraulic control of the exhaust valves
To open an exhaust valve hydraulically at the end of a compression stroke, optimum use is made of the valve diagram.
This means that the DEB uses an exhaust valve rocker of one cylinder to open an exhaust valve for another cylinder.

Cylinders 1, 2, and 3
Exhaust valve rocker of cylinder 1 hydraulically opens the exhaust valve of cylinder 3

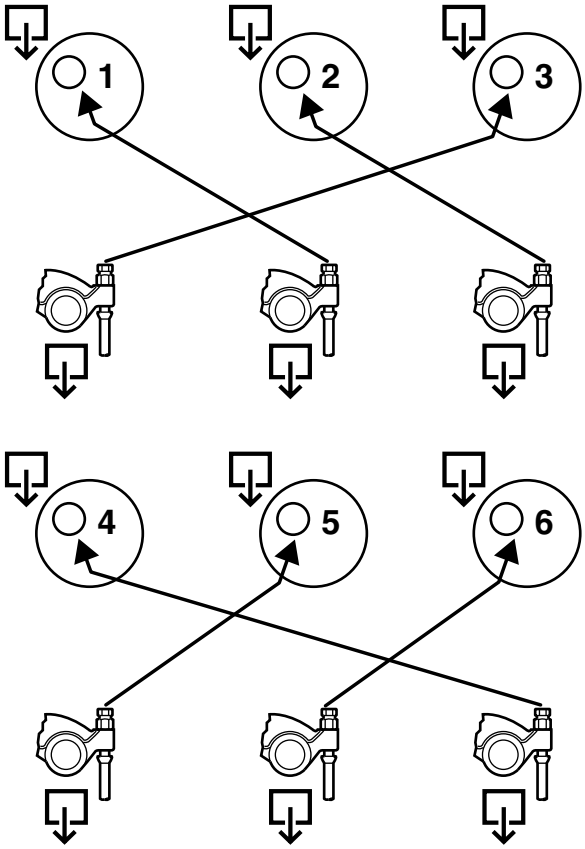
Exhaust valve rocker of cylinder 2 hydraulically opens the exhaust valve of cylinder 1

Exhaust valve rocker of cylinder 3 hydraulically opens the exhaust valve of cylinder 2

Cylinders 4, 5, and 6
Exhaust valve rocker of cylinder 4 hydraulically opens the exhaust valve of cylinder 5

Exhaust valve rocker of cylinder 5 hydraulically opens the exhaust valve of cylinder 6

Exhaust valve rocker of cylinder 6 hydraulically opens the exhaust valve of cylinder 4



i 400178

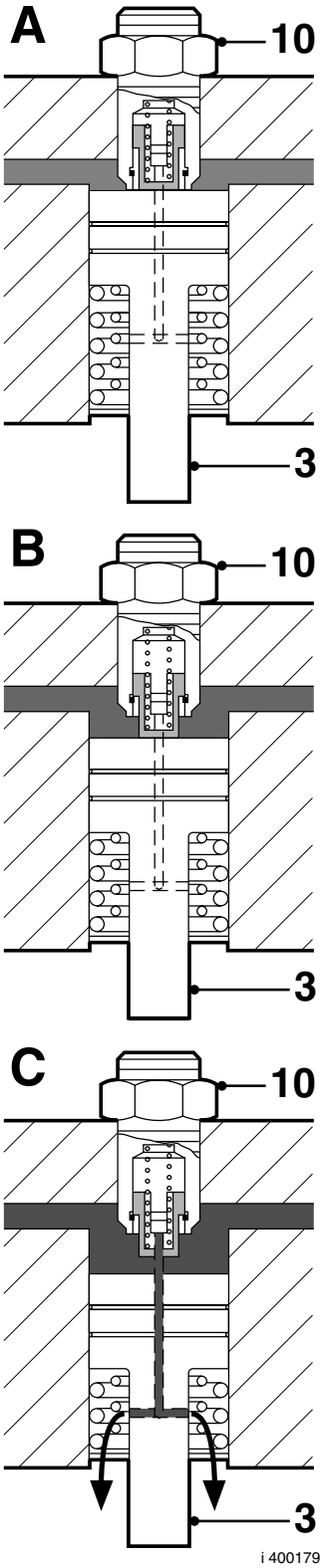
10

Preventing the exhaust valve from opening too far
Inside the set screw (10) is a spring-loaded pin. This pin protrudes approx. 2.7 mm from the set screw (10).
The operating piston (3) has a hole which is closed by the pin in the set screw (10).
If the operating piston (3) is hydraulically moved too far down, the hole in the operating piston (3) will no longer be closed. Oil in the high-pressure area escapes via the hole in the operating piston (3), preventing the exhaust valve from opening any further.

Position A:
Operating piston inactive.

Position B:
Operating piston during regular operation.

Position C:
Operating piston hydraulically opened too far, oil pressure is discharged via the operating piston.



Protection against excessive lubricating oil pressure
There are 2 springs above the control valve.
When the DEB is switched on, the control valve will be moved upwards by the engine oil pressure against the direction of the pressure of the inner spring.
This clears the way for the lubricating oil to pass to the high-pressure area of the DEB.
If the lubricating-oil pressure in the engine is too high (≥ 8 bar), the control valve will be moved upwards against the pressure of both springs.
The control valve will move up further than usual, preventing the route to the high-pressure area of the DEB from being cleared.
The DEB will not function in this case.

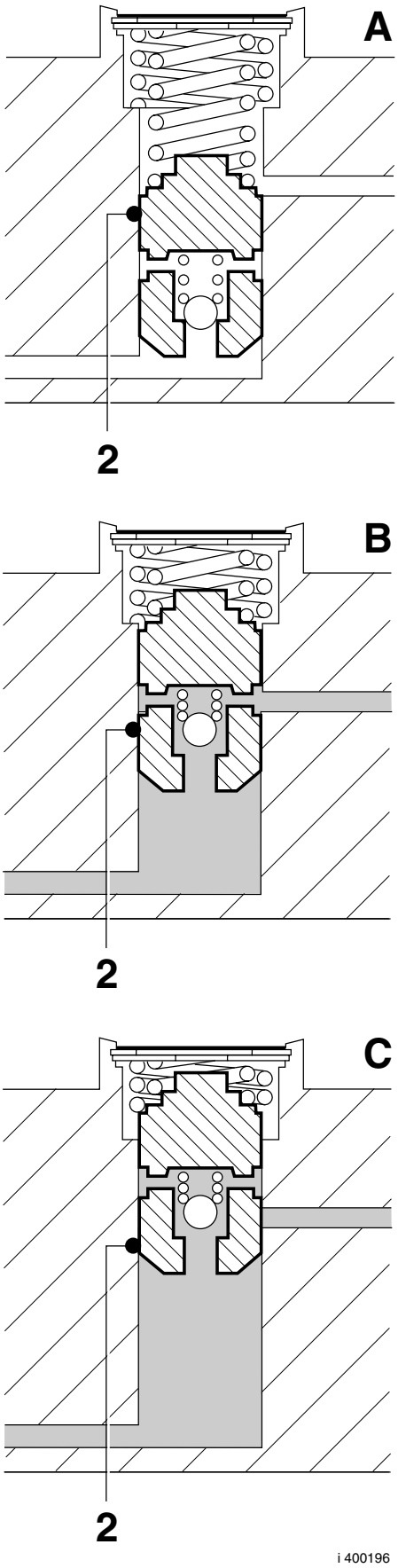
Note:
A pressure in excess of 8 bar may result from:

- cold lubricating oil
- defective lubricating-oil pressure-relief valve

Position A:
DEB disengaged

Position B:
DEB engaged
Lubricating oil pressure between 1.5 and 8 bar

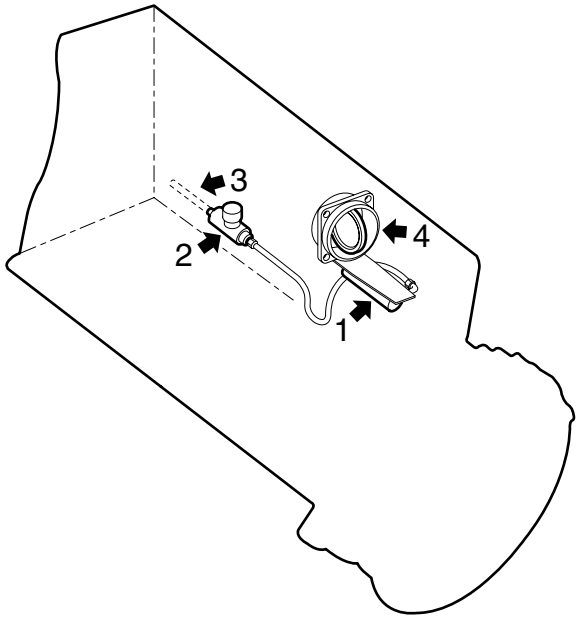
Position C:
DEB engaged
Lubricating-oil pressure approx. 8 bar



10

2.6 SYSTEM DESCRIPTION, EXHAUST BRAKE

1. Butterfly valve operating cylinder
2. Exhaust brake valve
3. Supply pressure
4. Butterfly valve



I400533

Switching on the exhaust brake
The exhaust brake consists of an engine brake operating switch fitted in the cab floor and an operating cylinder (2) connected to the butterfly valve in the exhaust pipe.
If the engine brake control switch is operated, a signal is passed to the engine management system's electronic unit. The engine management system's electronic unit interrupts the fuel supply to the various cylinders. The unit also energises the exhaust brake valve, causing compressed air to flow to the operating cylinder (2). The cylinder closes the butterfly valve in the butterfly valve housing. The exhaust pipe is then almost completely closed off.
Controlled discharge of exhaust gases is still possible through a calibrated hole in the butterfly valve.
The engine now acts as a compressor, creating a braking action.
The higher the engine speed, the greater the braking action of the exhaust brake.

Switching off the exhaust brake
If the engine brake control switch is released, the fuel supply to the various cylinders will be re-instated and the butterfly valve will be re-opened.

10

10

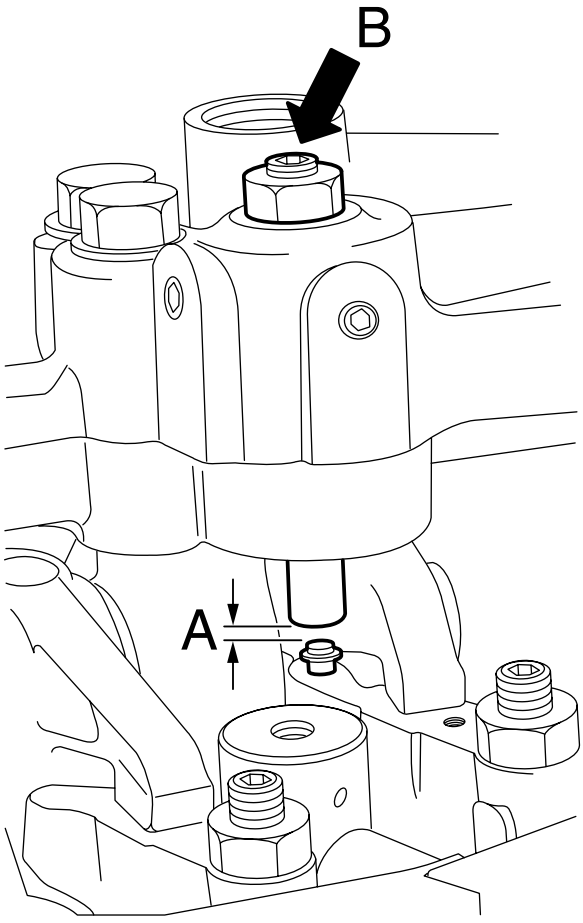
© 200324

3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION AND ADJUSTMENT, DEB CLEARANCE

When the engine or parts thereof are opened, it is possible for dirt to penetrate which can result in serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

1. Remove the valve covers.
2. Tighten the DEB attachment bolts to the specified torque. See "Technical data".
3. Using the special tool (DAF no. 1310477), crank the engine in the direction of rotation until cylinder 1 has reached the top dead centre (TDC) and the valves of cylinder 6 are in overlap position.
4. Use set screw B to set the DEB clearance (A) of cylinders 1, 3 and 5. See "Technical data". Tighten the lock nut to the specified torque. See "Technical data".
5. Using the special tool (DAF no. 1310477), crank the engine in the direction of rotation until cylinder 6 has reached the top dead centre (TDC) and the valves of cylinder 1 are in overlap position.
6. Use set screw B to set the DEB clearance (A) of cylinders 2, 4 and 6. See "Technical data".
7. Tighten the lock nut to the specified torque. See "Technical data".
8. Fit the valve covers.



i 400166

10

3.2 FUNCTIONAL CHECK, DEB

Electrical inspection of DEB

1. Disconnect both DEB connectors at the valve cover.

2. Check the solenoid valve for an open circuit and for the correct resistance value using a multimeter (set to the resistance value position). See "Technical data".

3. Check whether the solenoid valve is short-circuited to the vehicle's earth.

4. Connect a multimeter (set to the volt measuring position) to the engine cable harness.

5. Start the engine and, using the accelerator pedal, increase the engine speed to approx. 1500 rpm.

Activate the engine brake using the engine brake control switch on the cab floor. The multimeter should display a voltage reading. See "Technical data".

Note:
As the electronic UPEC unit checks the activation of the engine brake, it will disengage the engine brake below a certain engine speed (see UPEC system manual).

10

Mechanical inspection of DEB

When the engine is run without the valve covers, hot lubricating oil may escape from the engine. Make sure you are adequately protected.

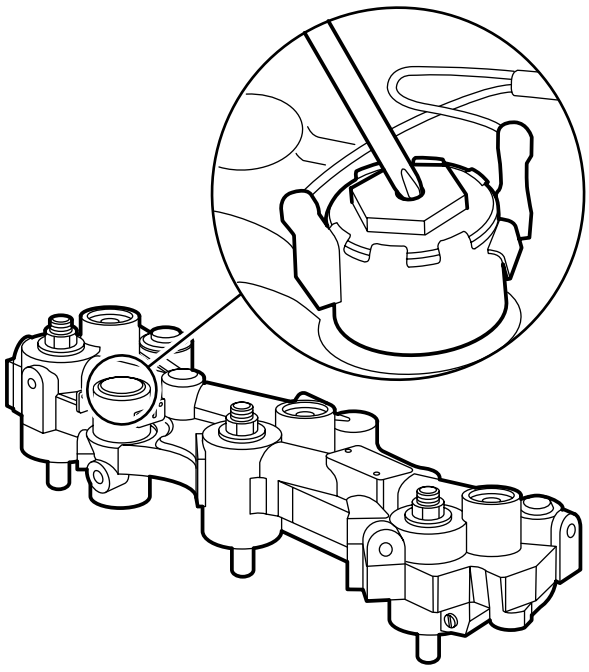
When the engine or parts thereof are opened, it is possible for dirt to penetrate which can result in serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Note:
If the DEB was removed, the DEB must first be switched on and off several times with the engine running to bleed the DEB and fill it with lubricating oil.

1. Remove the valve covers.
2. Start the engine and run it at idling speed.

   Note:
   When the DEB is mechanically switched on, the fuel injection is **not** switched off. Each DEB should therefore be activated for as brief a period of time as possible.

3. Use a small screwdriver to push the pin in the centre of the solenoid valve downwards. The DEB has now been activated mechanically.
4. Visually check whether the main and operating pistons of the DEB move and/or the exhaust valve is opened.
5. When the DEB is switched off, check whether lubricating oil is discharged from the control valves.
6. Fit the valve covers.



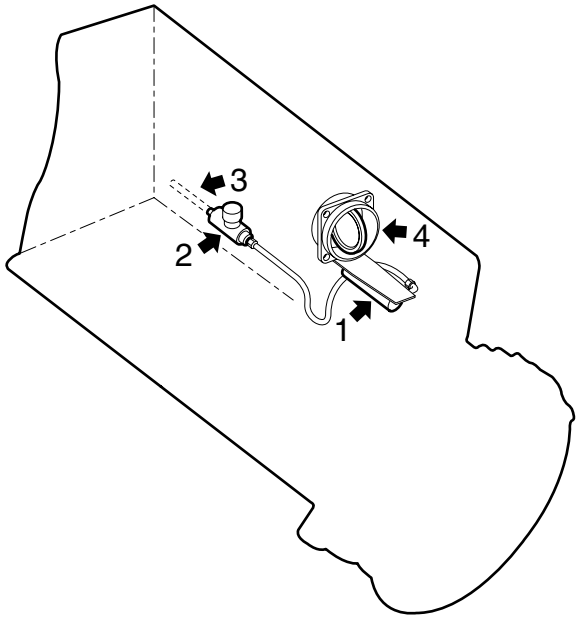
i 400236

10

3.3 INSPECTION AND ADJUSTMENT, EXHAUST BRAKE

Checking exhaust brake

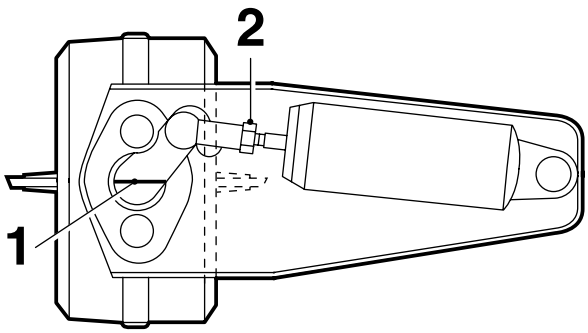
1. Use air pressure to check the exhaust brake (4) for smooth operation.
   This can be done by electrically activating the exhaust brake valve (2) or by pressurising the exhaust brake cylinder (1) yourself.



I400533

Setting the exhaust brake

1. Release the ball head of the butterfly valve control lever.
2. Open the butterfly valve fully (exhaust brake inactive), indicated by the mark (1) on the butterfly valve shaft.
3. Set the length of the piston rod (2), making sure that without air pressure a pre-load of 1 to 2 mm is present.



I400186

10

4. REMOVAL AND INSTALLATION

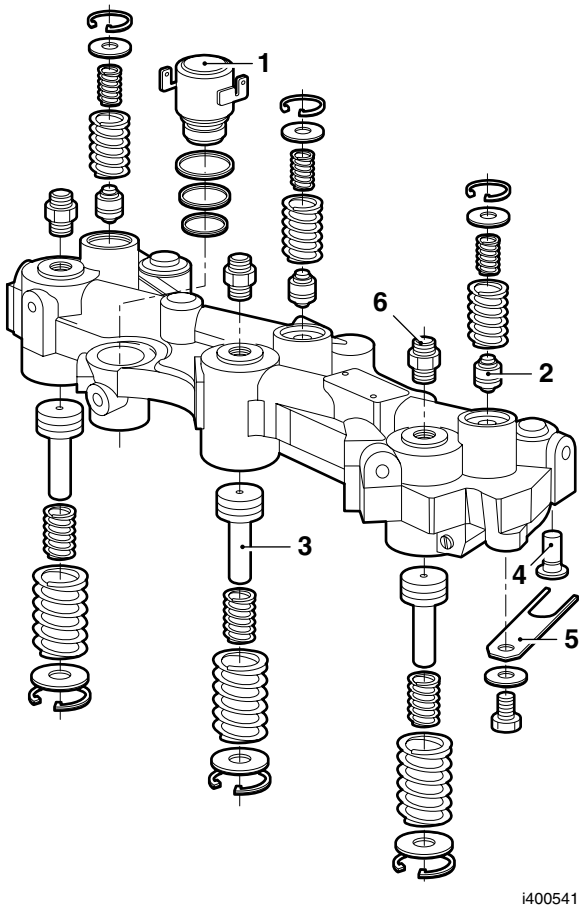
4.1 REMOVAL AND INSTALLATION, DEB

Make sure that the spring plate (5) under the main piston (4) is not damaged or deformed. When the DEB is in operation, this spring plate, if it is damaged or deformed, can break off and result in serious damage to the engine.

When the engine or parts thereof are opened, it is possible for dirt to penetrate which can result in serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the DEB

1. Remove the valve cover.
2. Disconnect the electrical connection and remove the cable harness from its housing.
3. Remove the DEB.



i400541

10

Installing the DEB

1. Tighten the rocker seat attachment bolts to the specified torque. See "Technical data".

   Note:
   There are two different DEB housings, one for cylinders 1 to 3 and one for cylinders 4 to 6 (shown as "front" and "rear" on the DEB housing).

2. Place the DEB on the rocker seats.

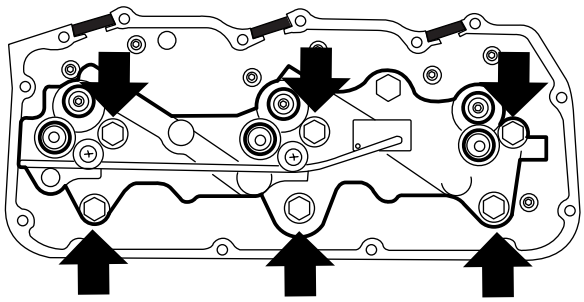
3. Insert the DEB attachment bolts and tighten them to the specified torque. See "Technical data".

4. Attach the electrical connection.

5. Adjust the valve clearance. See "Inspection and adjustment".

6. Adjust the DEB clearance. See "Inspection and adjustment".

7. Fit the valve cover.



i 400187

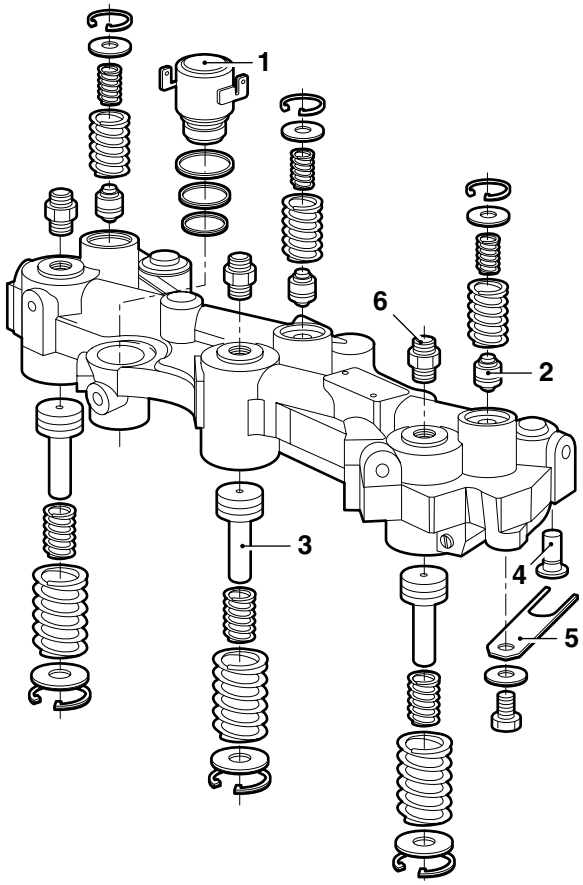
10

© 200324

4.2 REMOVAL AND INSTALLATION, DEB SPRING PLATE

Removing the DEB spring plate

1. Remove the DEB.
2. Remove the spring plate (5) with shim and attachment bolt.



i400541

10

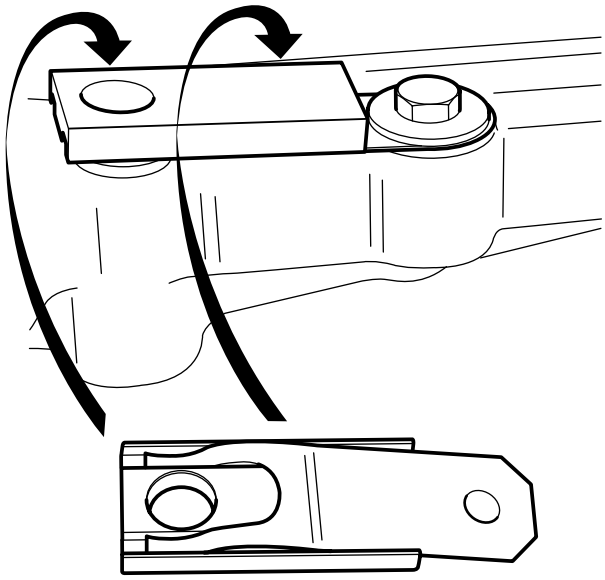
Installing the DEB spring plate

Note:
To prevent the spring plate being damaged and/ or broken, it should be positioned very carefully.

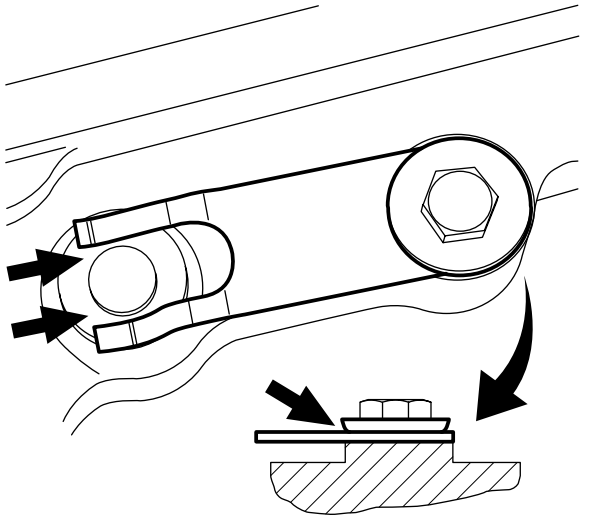
1. Use the special tool (DAF no. 1329321) to position the spring plate (5) on the main piston (4).

2. Fit the lock washer with fixing bolt and tighten it to the specified tightening torque. See "Technical data".

3. Install the DEB and tighten the attachment bolts to the specified torque. See "Technical data".



i 400239



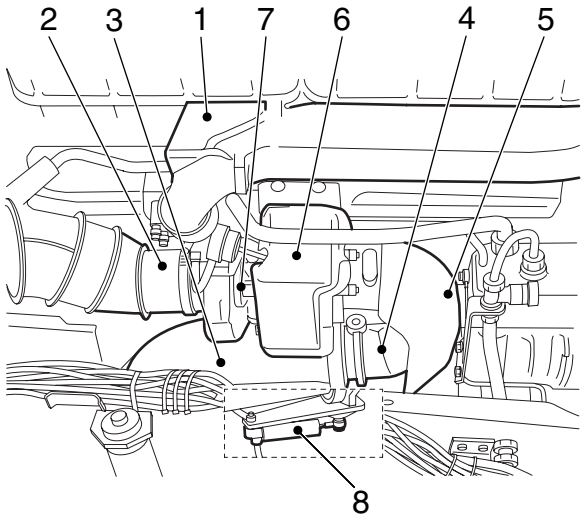
i400238

© 200324

4.3 REMOVAL AND INSTALLATION OF EXHAUST BRAKE

Removing the exhaust brake

1. Disconnect the air connection from the exhaust brake cylinder (8).
2. Remove the heat shield (5).
3. Remove the nuts attaching the exhaust brake (4) to the turbocharger (7).
4. Remove the clamping strip from the exhaust pipe (3).
5. Remove the entire exhaust brake (4).



Installation, exhaust brake

1. Check the butterfly valve for smooth operation.
2. Check the sealing faces of the exhaust brake (4) and the exhaust pipe (3).
3. Clean the attachment bolts and apply heat-resistant grease to the threads.
4. Position the exhaust brake (4) between the turbocharger (7) and the exhaust pipe (3).
5. Secure the clamping strip of the exhaust pipe (3), attach the turbocharger (7) on the exhaust manifold flange and secure the attachment nuts to the specified tightening torque. See "Technical data".
6. Fasten the heat shield (5) and tighten the attachment bolts to the specified torque. See "Technical data".
7. Check the setting of the exhaust brake; see "Inspection and adjustment".

10

10

© 200324